LGC GEO-ENVIRONMENTAL, INC.

PRELIMINARY GEOTECHNICAL INVESTIGATION REPORT, PROPOSED OFFICE BUILDING AND WORKSHOP, 26501 MADISON AVENUE, CITY OF MURRIETA, RIVERSIDE COUNTY, CALIFORNIA, APN: 910-230-003.

Dated: April 25, 2019
Project No. G19-1706-10

Prepared For:

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April 25, 2019

Project No. G19-1706-10

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Subject: ***Preliminary Geotechnical Investigation Report, Proposed Office Building and Workshop, 26501 Madison Avenue, City of Murrieta, Riverside County, California, APN: 910-230-003.***

LGC Geo-Environmental, Inc. (LGC) is pleased to submit herewith our preliminary geotechnical investigation report regarding proposed office building and workshop development of the subject property (the site), which is located at 26501 Madison Avenue, City of Murrieta, Riverside County, California. The site is identified as Assessor's Parcel Number 910-230-003.

This report presents the results of our research of published geologic/geotechnical reports and maps, geologic mapping and review of aerial imagery, field exploration and laboratory testing; in addition to our geotechnical and geologic judgment, opinions, conclusions and preliminary recommendations associated with the proposed office building and workshop development.

Based on the results of our field exploration, geologic mapping, field and laboratory testing, geologic and geotechnical engineering evaluations, along with our review of published literature and the referenced Site Plan it is our opinion that the subject site is suitable for the proposed office building and workshop development provided that the recommendations presented herein are utilized during the design, grading, and construction. LGC should review any grading plans, as well as any foundation/structural plans when they become available, and revise the recommendations presented herein, if necessary.

It has been a pleasure to be of service to you during the design stages of this project. If you have any questions regarding the contents of this report or should you require additional information, please do not hesitate to contact us.

Respectfully submitted,

LGC GEO-ENVIRONMENTAL, INC.

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1.0 INTRODUCTION

1.1 Purpose

This report presents the results of LGC Geo-Environmental, Inc.'s (LGC's) preliminary geotechnical investigation regarding proposed office building and workshop development of the subject property (the site), which is located at 26501 Madison Avenue, City of Murrieta, Riverside County, California. The site is identified as Assessor's Parcel Number (APN) 910-230-003.

In February 2019, LGC conducted a phase I environmental site assessment for the subject site, the results of which are documented in the referenced *Phase I Environmental Site Assessment* by LGC dated February 28, 2019.

The purpose of this preliminary geotechnical investigation is to determine the nature of surface and subsurface soil conditions, evaluate their characteristics, and provide geotechnical recommendations with respect to grading, construction, foundation design and other aspects relative to the proposed office building and workshop development of the subject site. The referenced 40-scale Site Plan by dk Greene Consulting, Inc. (undated), which depicts the site, was utilized as the base map for our Geotechnical Map for the site (Plate 1).

1.2 Scope of Services

Our scope of services included the following:

- Review of previous preliminary geotechnical and geologic reports for the site, as well as readily available published geologic maps, recent aerial imagery, and pertinent documents regarding the anticipated geologic and geotechnical conditions at the site (Appendix A).
- Geologic observations and mapping of the existing surface conditions on the site.
- Field exploration consisting of excavating nine exploratory trenches (TR-1 through TR-9) to determine existing subsurface geological conditions using a wheeled backhoe.
- Laboratory testing of selected representative samples of soil for characterization of the engineering properties of onsite soil.
- Geotechnical engineering and geologic analysis of the data with respect to the proposed office building and workshop development.
- Preparation of this report presenting our findings, conclusions, and preliminary geotechnical design recommendations for the proposed office building and workshop development.

1.3 Site Description and Topography

Located along the southwest side of Madison Avenue at its intersection with Golden Gate Circle, the subject site is approximately rectangular and comprises approximately 5.83 acres (Site Location Map, Figure 1). The site is vacant and unfenced. In the northwest there is an inactive water well which was installed in 2017; the well has a steel standpipe with a welded cap. During the 1980s and early 1990s, there was apparently a single-family residence (SFR) and another structure on the northeast part of the site along Madison Avenue. The former SFR was probably served by an onsite wastewater treatment system (OWTS). If there is or was an OWTS on the site, its location is unknown.

The regional surface slope for the site and surrounding area is generally toward the southwest. Ground surface elevations on the site range from approximately 1,088 feet above mean sea level (msl) along the northwest property line to approximately 1,040 feet above msl in the channel of Warm Springs Creek near the south property corner, based on the referenced 30-scale *Non-Specific Rough Grading Plan* by Saxon Engineering Services, Inc. (Saxon). An existing 2:1 (h:v) cut slope up to approximately 20 feet high descends southwest from the northwest part of the site toward an offsite parking area. There is an elevated L-shaped area in the northwest and northeast, which is partially underlain by undocumented artificial fill. The northwest portion is a bench; a cut slope ascends northwest from the bench toward higher ground offsite. The bench and a small adjoining pad, together with the access road from Madison Avenue in the northeast, were graded in 2017 for equipment access to drill and install the onsite water well. The northeast portion consists of an arcuate pad which includes the site of the former SFR; graded slopes descend southwest, southeast and northeast from the pad. The south portion of the site is apparently ungraded natural ground, including the steeply-sloped, incised channel of Warm Springs Creek. Most onsite stormwater, together with tributary runoff from the elevated offsite area to the northwest, apparently flows into Warm Springs Creek.

0 ft. 50 ft. 100 ft. 200 ft.

Map distances are approximate
Map base reproduced from Google Earth photo (08/13/2018).

Legend
Approximate Site boundary

FIGURE 1
SITE LOCATION MAP

Project Name	Lyles Diversified – Murrieta
Project No.	G19-1706-10
Geol./Eng.	DW/LDC
Scale	1" = 100'
Date	April 2019

1.4 Previous Preliminary Geotechnical Investigation

In 2017, a previous preliminary geotechnical investigation was conducted on the subject site, the results of which are documented in *Geotechnical Investigation, Proposed Covered Outdoor Storage Facility, 26501 Madison Avenue, Murrieta, California* by Global Geo-Engineering, Inc. (Global), dated November 17, 2017 (Appendix B). Nine exploratory borings were drilled, logged and sampled to depths ranging from approximately 8.0 feet to 18.5 feet below ground surface (bgs). Groundwater was not encountered in any of the nine borings. Limited soil testing was conducted using soil samples from the borings. Global placed a perforated pipe for future percolation testing in its boring P-1 in the south part of the site (Figure 1). Global reportedly did not perform percolation testing in boring P-1, but the pipe remains.

1.5 Proposed Development and Grading

The referenced 30-scale *Non-Specific Rough Grading Plan* by Saxon indicates that the following grading is proposed for the site. Most of the site will consist of a proposed cut/fill pad that will slope gently toward the south at approximately 2.7 percent grade. At the perimeters of the pad, proposed 2:1 (h:v) cut and fill slopes, as well as the existing 2:1 cut slope in the northwest part of the site, will transition from the proposed pad to adjoining offsite and onsite grade. Surface water flow will be directed toward a proposed infiltration device which will be located in the southwest area of the site. The proposed development will consist of an office building with an asphalt-paved parking area in the northwest and a workshop building with a gravel parking area in the southeast, together with two driveways extending from Madison Avenue, landscaped areas and hardscape areas. It is anticipated that the proposed structures will be constructed of wood and/or steel framing, with concrete footings and floor slabs constructed on-grade. The currently unimproved portion of Madison Avenue, which adjoins the site to the northeast, will be improved/paved extending northwest to the existing end of pavement.

1.6 Historical Aerial Photograph and Topographic Map Evaluation

Historical aerial photographs of the site dating back to 1938, as well as historical topographic maps dating back to 1901, were reviewed as part of LGC's prior Phase I ESA. In addition, Google Earth Pro imagery (from 1994 to 2018) for the site and surrounding area was evaluated. Information from these sources, as it pertains to the geologic and geotechnical issues of the proposed development, is included herein.

2.0 FIELD EXPLORATION

2.1 Surface Reconnaissance

Surface reconnaissance of the subject site and accessible surrounding areas was accomplished by an LGC geologist during February and March 2019 to document existing surface geological conditions using the referenced Site Plan for plotting geologic units. This information has been plotted on the enclosed Geotechnical Map (Plate 1)

2.2 Field Exploration

Prior to subsurface work, underground utilities clearance was obtained from Underground Service Alert of Southern California. Subsurface exploration at the subject site was performed on March 15, 2019 and involved excavating nine exploratory trenches (TR-1 through TR-9) to depths ranging from approximately 4.5 feet to 10.5 feet bgs using the backhoe.

Earth materials encountered within the exploratory trenches were classified and logged by an LGC geologist in accordance with the visual-manual procedures of the Unified Soil Classification System (USCS). At the conclusion of the subsurface exploration, all trenches were backfilled with excavated soil, using minor compactive effort. Minor settlement of the backfill soil may occur over time. The approximate locations of the exploratory trenches are shown on the Geotechnical Map (Plate 1).

2.3 Laboratory Testing

During our subsurface exploration, representative samples of earth materials were collected for laboratory testing. Laboratory testing was performed on selected representative samples of onsite earth materials and included in-situ and maximum density and optimum moisture content, chloride content, sulfate content, minimum resistivity and pH, expansion index, atterburg limits, consolidation, direct shear, and R-value. Laboratory test data are presented in Appendix D, together with brief descriptions of the test criteria.

3.0 FINDINGS

3.1 Regional Geologic Setting

Regionally, the site is within the Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are characterized by steep, elongated valleys and mountain ranges that trend west and northwest. The mountainous areas are underlain by Pre-Cretaceous metasedimentary and metavolcanic rocks and Cretaceous plutonic rocks of the Southern California Batholith. The valleys are underlain by young alluvial deposits followed by Quaternary and Tertiary bedrock units (sandstones, mudstones and conglomerates, as well as volcanics). The site and surrounding area are primarily underlain by sandstone bedrock of Pauba formation (Pleistocene). Young alluvial fan deposits (Holocene and late Pleistocene) overlie Pauba formation bedrock in the southwest and south parts of the site including in Warm Springs Creek (U.S. Geologic Survey (USGS), 2003). Regional geology is presented on the Regional Geologic Map (Figure 2).

The northwest-southeast trending topography for the area is controlled by the Elsinore fault zone (EFZ), which extends northwesterly approximately 190 miles from San Diego County through Riverside County to southeastern Los Angeles County. The EFZ separates the Perris Block on the northeast, which includes the site, from the Santa Ana Mountains Block on the southwest. The subject site is not underlain by active faults. A short trace of the Wildomar fault, which is not designated an active fault, is located approximately 0.10 mile southwest of the site. The nearest active fault is the Wildomar fault, which is part of the EFZ and is located approximately 0.19 mile southwest of site. A narrow portion of the site along the southwest property line is within the County Fault Zone, which has been established by Riverside County regarding the Wildomar fault (California Geologic Survey (CGS), 2018b and Riverside County, 2018).

3.2 Local Geology and Soil Conditions

Based on our review of available geological and geotechnical literature, together with field mapping and LGC's nine exploratory backhoe trenches, the subject site is primarily underlain by topsoil and bedrock of the Pauba formation (Sandstone member). In Warm Springs Creek and the southwest-center area, young alluvial-fan deposits (Holocene and late Pleistocene) overlie Pauba formation bedrock. The subsurface geological contacts are described in greater detail below and presented in the logs of the exploratory trenches (Appendix C). The observed geologic units and contacts are depicted on the Geotechnical Map (Plate 1).

- **Artificial Fill (Undocumented) (Afu):** There are apparently areas of undocumented artificial fill on downslope portions of the former SFR site and the bench/pad for the water well. The undocumented fill was encountered in several of LGC's exploratory trenches and ranges up to an estimated 8.0 feet thick. The undocumented fill is generally composed of silty to clayey sand, which are various shades of brown, damp to moist, loose to medium dense, very fine- to medium-grained, with roots and roothairs.
- **Topsoil:** Topsoil was encountered in LGC's exploratory trenches and ranges from approximately 0.5 foot to 1.0 foot thick. The topsoil is generally composed of silty to clayey sand and sandy clay, which are various shades of brown, damp to very moist, loose, fine- to medium-grained, with pores, roots and roothairs.
- **Young Alluvial Fan Deposits (Qyf):** Holocene and late Pleistocene age young alluvial fan deposits (Qyf) overlie Pauba formation bedrock in the southwest and south parts of the site including in Warm Springs Creek and in an onsite drainage that trends approximately north across the site. The young alluvial fan deposits were encountered in LGC's exploratory trenches generally and range from approximately 2.5 feet to 9.0 feet thick. The young alluvial fan deposits are generally composed of silty to clayey sand and sandy silt and clay, which are various shades of brown, damp to wet, loose to dense, very fine- to coarse-grained, with pores.
- **Pauba Formation (Qpfs):** Pleistocene age bedrock of the Pauba formation (Sandstone member) was encountered underlying the undocumented artificial fill, topsoil and young alluvial fan deposits to the maximum depth of approximately 10.5 feet bgs in LGC's exploratory trenches on the subject site. Approximately the upper 1.0 foot to 2.0 feet are generally weathered to clayey sand, sandy silt and poorly-graded sand. The Pauba formation is generally composed of sandstone (very fine- to coarse-grained and friable) and siltstone, which are various shades of brown, dry to moist, moderately hard to very hard.

0 ft. 1,000 ft. 2,000 ft. 4,000 ft.

Map distances are approximate

Legend

Approximate Site boundary

Map base reproduced from *Preliminary Geologic Map of the Murrieta 7.5' Quadrangle* (USGS, 2003).

FIGURE 2
REGIONAL GEOLOGIC MAP

Project Name	Lyles Diversified – Murrieta
Project No.	G19-1706-10
Geol./Eng.	DW/LDC
Scale	1" = 2,000'
Date	April 2019

3.3 Groundwater

Groundwater was not encountered to a maximum depth of approximately 10.0 feet bgs in the nine exploratory trenches on the subject site during this preliminary geotechnical investigation. Groundwater was also not encountered to depths of approximately 8.0 feet to 18.5 feet bgs in any of the nine borings on the site during the previous preliminary geotechnical investigation by Global Geo-Engineering, Inc. in 2017. The California Department of Water Resources (DWR) *Water Data Library* website was reviewed regarding historical groundwater depths in wells near the subject site. The *Water Data Library* indicates State Well Number 335381N1171759W001 is the nearest well that is located on same side of Warm Springs Creek as the site. This well is located approximately 0.21 mile northeast of the site, and the only groundwater depth was recorded at 34 feet below ground surface (bgs) in 1968. In July and August 2017, a public water supply well was drilled and installed onsite in the northwest. This well is inactive (capped), and the recorded groundwater depth was 380 feet bgs on August 2, 2017 (Eric Haley dba Heritage Well Service, 2017).

3.4 Caving

Caving was not encountered within the nine exploratory trenches on the subject site during this investigation. Localized minor caving may occur within low-density portions of undocumented artificial fill and/or topsoil.

3.5 Surface Water

Based on our review of the referenced Site Plan, proposed onsite surface water flow from the proposed office building and adjoining paved parking area will be directed toward a proposed infiltration device which will be located in the southwest area of the site. Onsite surface water flow from the proposed workshop building and adjoining gravel parking area will be directed toward Warm Springs Creek. Surface water runoff relative to project design is the purview of the project civil engineer and should be designed to direct surface water runoff away from the proposed structures and walls. The southeast part of the site is within a 100-year flood zone associated with Warm Springs Creek; the zone extends approximately to the top of the west streambank.

3.6 Faulting

The geologic structure of the Southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. Faults such as the Newport-Inglewood, Whittier, Elsinore, San Jacinto and San Andreas, are major faults in this system and are known to be active and may produce moderate to strong ground shaking during an earthquake. In addition, the San Andreas, Elsinore and San Jacinto faults are known to have ruptured the ground surface in historic times.

The subject site is **not** underlain by active faults. A short trace of the Wildomar fault, which is not designated an active fault, is located approximately 0.10 mile southwest of the site (CGS, 2018b). The nearest active fault is the Wildomar fault, which is part of the EFZ and is located approximately 0.19 mile southwest of site. A narrow portion of the site along the southwest property line is within the County Fault Zone, which has been established by Riverside County regarding the Wildomar fault (CGS, 2018b and Riverside County, 2018).

Table 1 is a list of the significant faults located within 20 miles of the site (site coordinates of 33.5346°N, -117.1768°W). We have also included the Maximum Earthquake Magnitude predicted for each of these faults.

TABLE 1
SIGNIFICANT FAULTS IN PROXIMITY OF THE SITE

FAULT NAME	APPROXIMATE DISTANCE (mi)	MAXIMUM EARTHQUAKE MAGNITUDE (Mw)
Elsinore - Temecula (Wildomar)	0.2	6.8
Elsinore – Glen Ivy	12.6	6.8
Elsinore - Julian	14.5	7.1

Sources: EQFAULT for Windows Version 3.00b and Riverside County *Map My County* GIS Website

3.7 Secondary Seismic Effects

Secondary effects of seismic shaking resulting from large earthquakes on the major faults in the Southern California region, which may affect the site, include soil liquefaction and dynamic settlement. Other secondary seismic effects include shallow ground rupture, lateral spreading, seiches and tsunamis. In general, these secondary effects of seismic shaking are a possibility throughout the Southern California region and are dependent on the distance between the site and causative fault, and the onsite geology. An evaluation of these secondary seismic effects is included herein.

3.8 *Liquefaction*

Liquefaction is a seismic phenomenon in which loose, saturated, granular soils behave similarly to a fluid when subject to high-intensity ground shaking. Liquefaction occurs when three general conditions exist: 1) shallow groundwater; 2) low density non-cohesive (granular) soils; and 3) high-intensity ground motion. Studies indicate that saturated, loose to medium dense, near surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential.

The site is located within a Riverside County designated liquefaction hazard zone. Groundwater was not encountered in the nine exploratory trenches to a maximum depth of approximately 10.5 feet bgs during this preliminary geotechnical investigation on the subject site. Groundwater was also not encountered in the nine borings to a maximum depth of approximately 18.5 feet bgs during the previous preliminary geotechnical investigation by Global in 2017.

From the exploratory trenches and borings on the subject site, and review of the historic high groundwater data in the area (see section 3.3), a groundwater depth of 34 feet bgs was used for the liquefaction analyses. The analyses of proposed post-graded conditions did not indicate potentially liquefiable soils other than young alluvial fan deposits which extend to a maximum depth of approximately 9.0 feet bgs in the proposed development area. The Pauba formation bedrock that underlies the young alluvial fan deposits are not considered to be potentially liquefiable. Therefore, liquefaction does not present itself as a possible constraint for the proposed development.

3.9 *Subsidence*

The site is located within a Riverside County designated active subsidence zone. Unfavorable ground subsidence is not anticipated due to: recommended overexcavation associated with proposed structures and improvements and subsurface earth material types including Pauba formation bedrock.

3.10 *Landsliding*

Landslides or surface failures were not observed at or directly adjacent to the site. As a result, the possibility of the site being affected by land sliding is not anticipated.

3.11 *Shallow Ground Rupture*

The potential for shallow ground rupture is considered moderate at the site, due to potentially active faults near the site. Cracking because of shaking from nearby or distant seismic events is not considered a significant hazard, although it is a possibility at any site.

3.12 *Lateral Spreading*

Lateral spreading is the outward and downward movement of soil adjacent to a descending slope that occurs during a seismic event and is usually associated with liquefaction of underlying soils. This typically occurs adjacent to drainage channels as the affected soil moves laterally into the open channel area. The potential for lateral spreading is not considered to be a concern, due to the relatively hard nature of Pauba formation bedrock.

3.13 *Tsunamis and Seiches*

Based on the elevation and location of the site with respect to sea level and its distance from large open bodies of water, the potential of seiches and/or tsunamis is considered to be a nil possibility.

4.0 *CONCLUSIONS AND RECOMMENDATIONS*

Based on the results of our geotechnical investigation, it is our opinion that the proposed office building and workshop development as indicated on the referenced Site Plan and *Non-Specific Rough Grading Plan*, is feasible from a geotechnical and geologic standpoint provided that the following recommendations are incorporated into the design criteria and project specifications. When grading and foundation/structural plans for the proposed development are available, a comprehensive plan review should be performed by LGC. Depending on the results, additional recommendations may be necessary for geotechnical design parameters for both earthwork and foundations. Grading should be conducted in accordance with local and state codes, including the 2016 edition of the California Building Code (CBC), the recommendations within this report, and future geotechnical reports. It is also our opinion that the proposed grading and construction will not adversely impact the geologic stability of adjoining properties.

The following is a summary of the primary geotechnical factors, as determined from our geotechnical evaluation of the data, published/unpublished literature, and geotechnical reports:

- Based on our subsurface exploration, the site is underlain by topsoil, young alluvial fan deposits, and Pauba formation bedrock, as well as localized undocumented artificial fill associated with former structures and previous grading.
- Groundwater is not considered a constraint for the proposed development.
- Active or potentially active faults are not known to exist on the site.
- There are no known landslides impacting the site.
- Laboratory test results of the upper soil on the site indicate a **VERY LOW** to **LOW** expansion potential. For the site, earth materials are considered to have a **LOW** expansion potential.
- Laboratory test results of the upper soil indicate a **MEDIUM** plasticity index and liquid limit.
- Laboratory test results of the upper soil indicate a **negligible** potential for soluble sulfate attack on normal concrete and **negligible** chloride effects on reinforcing steel.
- Laboratory test results of the upper soil encountered indicated a **moderate** corrosion potential to buried metals.
- The site is underlain by approximately 3 feet to 9 feet of potentially-compressible topsoil, young alluvial fan deposits and weathered Pauba formation bedrock, as well as localized undocumented artificial fill, which may be prone to potential intolerable post-grading settlement and/or hydroconsolidation, under the surcharge of the future proposed structural loads and/or fill loads. These materials should be overexcavated to underlying competent bedrock and/or young alluvial fan deposits.
- From a geotechnical perspective, the existing onsite soil appears to be suitable material for use as fill, provided that the onsite soil is relatively free from rocks (larger than 8 inches in maximum dimension), construction debris, and organic material. It is anticipated that the onsite soil and bedrock may be excavated with conventional heavy-duty construction equipment.

5.0 SEISMIC DESIGN CONSIDERATIONS

5.1 Ground Motion

The site will probably experience ground shaking from moderate- to large-size earthquakes during the life of the proposed development. Furthermore, it should be recognized that the Southern California region is an area of high seismic risk, and that it is not considered feasible to make structures totally resistant to seismic-related hazards.

Proposed structures on the site should be designed and constructed to resist the effects of seismic ground motions as provided in the 2016 CBC Sections 1613 and 1616, and 2010 ASCE 7. The method of design is dependent on the seismic zoning, site characterizations, occupancy category, building configuration, type of structural system, and building height.

Table 2 presents the seismic design parameters, which were developed based on the CBC 2016 and should be used for the proposed structures. Site coordinates of 33.5346°N, -117.1768°W were used to derive the seismic parameters in Table 2.

TABLE 2
SEISMIC DESIGN SOIL PARAMETERS

SEISMIC DESIGN SOIL PARAMETERS (2016 CBC Section 1613 and 2010 ASCE 7)	
Site Class Definition (ASCE 7; Chapter 20)	C
Mapped Spectral Response Acceleration Parameter S_s (for 0.2 second)	1.58
Mapped Spectral Response Acceleration Parameter, S_1 (for 1.0 second)	0.59
Site Coefficient F_a (0.2-second period)	1.20
Site Coefficient F_v (1-second period)	1.41
Adjusted Maximum Considered Earthquake (MCE) Spectral Response Acceleration Parameter S_{MS} (0.2-second period)	1.89
Adjusted Maximum Considered Earthquake (MCE) Spectral Response Acceleration Parameter S_{M1} (1-second period)	0.83
Design Spectral Response Acceleration Parameter, S_{DS} (0.2-second period)	1.26
Design Spectral Response Acceleration Parameter, S_{D1} (1-second period)	0.55
Mean Peak Ground Acceleration, PGA_m	0.84

Source: *ATC (Applied Technology Council) Hazards by Location* Website (Structural Engineers Association of California)

6.0 GEOTECHNICAL DESIGN PARAMETERS

6.1 Shrinkage/Bulking and Subsidence

Volumetric changes in earth quantities will occur when excavated onsite soils are replaced as properly compacted fill. Table 3 contains an estimate of the shrinkage and bulking factors for the various geologic units present onsite. These estimates are based on in-place densities of the various materials and on the estimated average degree of relative compaction that will be achieved during grading.

TABLE 3
ESTIMATED SHRINKAGE/BULKING

GEOLOGIC UNIT	SHRINKAGE/BULKING
Undocumented Artificial Fill	10% to 15% (Shrinkage)
Topsoil	5% to 10% (Shrinkage)
Young Alluvial Fan Deposits (Qyf)	5% to 10% (Shrinkage)
Pauba Formation Bedrock (Qpfs)	2% to 7% (Shrinkage)

Subsidence due to recompaction of exposed overexcavation bottom prior to fill placement, and placement of proposed fills, is estimated to be about 0.15 foot to 0.20 foot.

The above estimates of shrinkage and subsidence are intended as an aid for project engineers in determining earthwork quantities. These are preliminary rough estimates which may vary with depth of removal, stripping losses, field conditions at the time of grading, etc. However, these estimates should be used with some caution since they are not absolute values. Contingencies should be made for balancing earthwork quantities based on actual shrinkage and subsidence that occurs during the grading operations.

6.2 Cut/Fill Transition and Fill Differentials

To mitigate distress to structures related to the potential adverse effects of excessive differential settlement, cut/fill transitions should be eliminated from all building areas where the depth of fill placed within the "fill" portion exceeds proposed footing depths. The entire structure should be founded on a uniform bearing material. This should be accomplished by overexcavating the "cut" portion and replacing the excavated materials as properly compacted fill, so that all footings for structures and walls are founded into engineered fill with a minimum of 2 feet of fill below footings for proposed structures and 2 feet below footings for proposed walls. Recommended depths of overexcavation are provided in the following table:

TABLE 4
CUT/FILL TRANSITION

DEPTH OF FILL ("fill" portion)	DEPTH OF OVEREXCAVATION ("cut" portion)
Up to 4 feet	Equal Depth
4 to 12 feet	4 feet
Greater than 12 feet	One-third the maximum thickness of fill placed on the "fill" portion (20 feet maximum)

Overexcavation of the "cut" portion should extend beyond the perimeter building lines to a horizontal distance equal to the depth of overexcavation or to a minimum distance of 5 feet, whichever is greater.

6.3 *Excavation Characteristics*

It is anticipated that the onsite soil may be excavated with conventional heavy-duty construction equipment, based on our subsurface exploration and experience with these materials in the area.

6.4 *Compressible/Collapsible Soils*

The results of laboratory testing, together with field observations, indicate that the upper 3 feet to 9 feet of surficial materials are susceptible to varying degrees of intolerable settlement and/or hydro-consolidation (collapse) when a load is applied, or the soil is saturated. Consequently, these materials should be overexcavated to underlying competent Pauba formation bedrock and replaced as engineered fill.

7.0 SITE EARTHWORK

7.1 *General Earthwork and Grading Specifications*

Earthwork and grading should be performed in accordance with applicable requirements of the grading code of the County of Riverside, and in accordance with the following recommendations prepared by this firm. Grading should also be performed in accordance with the applicable provisions of the attached "General Earthwork and Grading Specifications for Rough Grading" (Appendix E) prepared by LGC, unless specifically revised or amended herein.

7.2 *Geotechnical Observations and Testing*

Prior to the start of grading, a meeting should be held at the site with the owner, developer, grading contractor, civil engineer and LGC to discuss the work schedule and geotechnical aspects of the grading. Rough grading, which includes clearing, overexcavation, scarification/processing and fill placement, should be accomplished under the full-time observation and testing of LGC. Fills should not be placed without prior approval from the geotechnical consultant.

A representative of LGC should also be present onsite during grading operations to document proper placement and compaction of fills, as well as to document excavations and compliance with the other recommendations presented herein.

7.3 *Clearing and Grubbing*

Weeds and grass in areas to be graded should be stripped and hauled offsite. Trees to be removed should be grubbed so that their stumps and major-root systems are also removed, and the organic materials hauled offsite. During site grading, laborers should clear from fills, roots and other deleterious materials missed during clearing and grubbing operations.

LGC or a qualified representative should be notified at the appropriate times to provide observation and testing services during clearing and grubbing operations to observe and document compliance with the above recommendations. In addition, buried structures, and any unusual or adverse soil conditions encountered that are not described or anticipated herein, should be brought to the immediate attention of LGC.

7.4 *Onsite Wastewater Treatment System Abandonment*

There is no information available regarding the former SFR that was located on the northeast part the site, but it was probably served by an OWTS. If there is or was an OWTS on the site, its location is unknown. If an OWTS is encountered during future grading and development onsite, then it should be removed and/or properly abandoned under permit from the Riverside County Department of Environmental Health (RCDEH).

7.5 *Water-Supply Well Abandonment*

An inactive (capped) water well was observed on the northwest part of the site (Figure 1). If the well is not intended to be used in the future, then it should be properly abandoned (destroyed) under permit from the RCDEH.

7.6 *Overexcavation and Ground Preparation*

The site is underlain by up to approximately 3 feet to 9 feet of potentially compressible topsoil and weathered bedrock, as well as localized undocumented artificial fill. These potentially compressible materials are considered unsuitable for support of proposed fills, structures, and/or improvements and should be overexcavated to expose underlying competent Pauba formation bedrock. Within the shallow fill or cut areas of the proposed building pads, overexcavations should also be 4 feet below proposed grade or a minimum of 2 feet below the proposed footings in the building pad areas, whichever is deeper. The overexcavation should also extend at least 5 feet outside the proposed building footprints (or a 1:1 projection away from the footing to the approved removal bottom, whichever is greater). Groundwater is not anticipated to be encountered during site grading. Actual depths of overexcavation should be evaluated upon review of final grading and foundation plans on the basis of observations and testing during grading by LGC.

Prior to placing engineered fill, exposed bottom surfaces in each overexcavated area should first be scarified to a depth of approximately 6 inches, watered or air-dried as necessary to achieve a uniform moisture content of optimum or higher and then compacted in place to a relative compaction of 90 percent or more (based on American Society for Testing and Materials (ASTM) Test Method D1557).

The estimated locations, extent and approximate depths for overexcavation of unsuitable materials are indicated on the enclosed Geotechnical Map (Plate 1). LGC should be provided with appropriate survey staking during grading to document that depths and/or locations of recommended overexcavation are adequate.

Sidewalls for overexcavations greater than 5 feet in height should be no steeper than 1:1 (h:v) and should be periodically slope-boarded during their excavation to remove loose surficial debris and facilitate mapping. Flatter excavations may be necessary for stability.

The grading contractor will need to consider appropriate measures necessary to excavate adjacent existing improvements adjacent to the site without endangering them due to caving or sloughing.

7.7 *Fill Suitability*

Earth materials excavated during grading are generally considered suitable for use as compacted fill provided they do not contain significant amounts of trash, vegetation, construction debris and oversize material. It will be necessary to blend the excavated soil to mitigate the high expansion potential of some of the upper soil.

7.8 *Oversized Material*

Oversized material that may be encountered during grading, greater than 8 inches, should be reduced in size or removed from the site.

7.9 *Benching*

Where compacted fills are to be placed on natural slope surfaces inclining at 5:1 (h:v) or greater, the ground should be excavated to create a series of level benches, which are at least a minimum height of 4 feet, excavated into competent bedrock.

7.10 *Fill Placement*

Fills should be placed in uncompacted lifts having a maximum 8-inch thickness, watered or air-dried as necessary to achieve a uniform moisture content of at least optimum moisture content, and then compacted in place to relative compaction of 90 percent or more. Fills should be maintained in a relatively level condition. The laboratory maximum dry density and optimum moisture content for each change in soil type should be determined in accordance with ASTM Test Method D1557.

7.11 Inclement Weather

Inclement weather may cause rapid erosion during mass grading and/or construction. Proper erosion and drainage control measures should be taken during periods of inclement weather in accordance with County of Riverside and California State requirements.

8.0 SLOPE CONSTRUCTION

8.1 Slope Stability

The full scope of proposed grading is not known at this time. The referenced *Non-Specific Rough Grading Plan* indicates that the following grading is proposed for the site, including the adjoining northeast site. Most of site (approximately 4 acres) will consist of a cut/fill pad at elevations ranging from approximately 1,058 feet to 1,073 feet above msl. At the perimeters of the pad, proposed 2:1 (h:v) cut and fill slopes up to approximately 15 feet high, as well as the existing 2:1 cut slope in the northwest, will transition from the proposed pad to adjoining offsite and onsite grade. The proposed and existing 2:1 cut and fill slopes should be grossly and surficially stable.

8.2 Fill Slopes

Following overexcavation of unsuitable soils, a 15-foot wide fill key excavated into competent bedrock should be provided at the toe of fill and fill over cut slopes. The bottom of the fill keys should be tilted at 2 percent back into the slope.

8.3 Cut Slopes

Proposed cut slopes may expose low-density, dry and/or cohesionless soils, which will likely require stabilization by overexcavation and replacement with compacted fill.

8.4 Temporary Excavations

Based on the physical properties of the onsite soils, temporary excavations exceeding 5 feet in height should be cut back at a ratio of 1:1 (h:v) or flatter, for the duration of the overexcavation and recompaction of unsuitable soil material. Temporary slopes excavated at the above slope configurations are expected to remain stable during grading operations. However, the temporary excavations should be observed by a representative of LGC for any evidence of potential instability. Depending on the results of these observations, revised slope configurations may be necessary.

Other factors which should be considered with respect to the stability of the temporary slopes include construction traffic and storage of materials on or near the tops of the slopes; construction scheduling; presence of nearby walls or structures on adjacent properties; drainage; and weather conditions at the time of construction. Applicable requirements of the California Construction and General Industry Safety Orders; the Occupational Safety and Health Act of 1970; and the Construction Safety Act should also be followed.

9.0 POST-GRADING CONSIDERATIONS

9.1 Control of Surface Water and Drainage Control

Positive-drainage device, such as sloping sidewalks, graded-swales and/or area drains, should be provided to collect and direct water away from the structure and slopes. Neither rain nor excess irrigation water should be allowed to collect or pond against building foundations. Roof gutters and downspouts should be provided on the sides of structures. Drainage should be directed to adjacent driveways, adjacent streets or storm-drain facilities. The ground surface adjacent to the structures should be sloped at a gradient of at least 5 percent for a distance of at least 10 feet, and further maintained by a swale or drainage path at a gradient of at least 2 percent. Where necessary, drainage paths may be shortened by use of area drains and collector pipes. The civil engineer is responsible for designing drain control devices on the site.

Planters with open bottoms adjacent to buildings should be avoided. Planters should not be designed adjacent to buildings unless provisions for drainage, such as catch basins, liners, and/or area drains, are made. Over watering must be avoided.

9.2 Utility Trenches

Utility-trench backfill within roadways, utility easements, under walls, sidewalks, driveways, floor slabs and any other structures or improvements should be compacted. The onsite soils should generally be suitable as trench backfill provided they are screened of rocks and other material over 3 inches in diameter and organic matter. Trench backfill should be compacted in uniform lifts (generally not exceeding 6 inches to 8 inches in uncompacted thickness) by mechanical means to at least 90 percent relative density (per ASTM Test Method D1557).

Where onsite soils are utilized as backfill, mechanical compaction should be used. Density testing, along with probing, should be performed by LGC or its representative, to document proper compaction.

If trenches are shallow and the use of conventional equipment may result in damage to the utilities; clean sand, having sand equivalent (SE) of 30 or greater, should be used to bed and shade the utilities. Sand backfill should be densified. The densification may be accomplished by jetting or flooding and then tamping to ensure adequate compaction. A representative from LGC should observe, probe, and test the backfill to verify compliance with the project specifications.

Utility-trench sidewalls deeper than 5 feet should be laid back at a ratio of 1:1 (h:v) or flatter or braced. A trench box may be used in lieu of shoring. If shoring is anticipated, LGC should be contacted to provide design parameters.

To avoid point-loads and subsequent distress to clay, cement or plastic pipe, imported sand bedding should be placed 1 foot or more above pipe in areas where excavated trench materials contain significant cobbles. Sand-bedding materials should be compacted and tested prior to placement of backfill.

Where utility trenches are proposed parallel to building footings (interior and/or exterior trenches), the bottom of the trench should not be located within a 1:1 (h:v) plane projected downward from the outside bottom edge of the adjacent footing.

10.0 PRELIMINARY FOUNDATION DESIGN RECOMMENDATIONS

10.1 General

Provided that site grading is performed in accordance with the recommendations of this report, conventional shallow foundations are still considered feasible for support of the proposed structures. Tentative foundation recommendations are provided herein. However, these recommendations may require modification depending on as-graded conditions within the building pad areas upon completion of grading.

10.2 Allowable-Bearing Values

An allowable-bearing value of 1,500 pounds per square foot (psf) may be used for 24-inch square pad footings and 12-inch or more wide continuous footings founded in compacted fill or competent native soil/material at a depth of 12 inches or more below the lowest adjacent final grade. This value may be increased by 20 percent for each additional foot of width and depth, to a value no greater than 1,800 psf.

10.3 Settlement

Based on the general settlement characteristics of compacted fill, as well as the aforementioned overexcavation recommendations and anticipated loading, it is estimated that the total settlement of conventional footings will be approximately 0.50 inch. Differential settlement is expected to be 0.25-inch over 30 feet. It is anticipated that the majority of the static settlement will occur during construction or shortly thereafter as building loads are applied.

The above settlement estimates are based on the assumption that the grading will be performed in accordance with the grading recommendations presented in this report and that LGC will observe or test the soil conditions in the footing excavations.

10.4 Lateral Resistance

A passive earth pressure of 250 psf per foot of depth, to a maximum value of 450 psf may be used to determine lateral-bearing resistance for footings. The passive earth pressure incorporates a minimum factor of safety of 1.5. Where structures are planned in or near descending slopes, the passive earth pressure should be reduced to 150 psf per foot of depth to a maximum value of 300 psf. In addition, a coefficient of friction of 0.35 times the dead-load forces may be used between concrete and the supporting soils to determine lateral sliding resistance. When combining passive and friction for lateral resistance, the passive component should be reduced by one third.

The above values are based on footings placed directly against engineered compacted fill. In the case where footing sides are formed, backfill placed against the footings should be compacted to 90 percent or more of maximum dry density as determined by ASTM D1557.

10.5 Footing Setbacks from Descending Slopes

Where structures are proposed near the tops of descending graded or natural slopes, the footing setbacks from the slope face should conform to the 2016 CBC, Figure 1808.7.1. The required setback is H/3 (one-third the slope height) measured along a horizontal line projected from the lower outside face of the footing to the slope face. The footing setbacks should be 5 feet where the slope height is 15 feet or less and up to a maximum of 40 feet where the slope height exceeds 15 feet.

10.6 Building Clearances from Ascending Slopes

Building setbacks from ascending graded or natural slopes should conform with the 2016 CBC, Figure 1808.7.1, which requires a building clearance of H/2 (one-half the slope height) varying from 5 to 15 feet. The building clearance is measured along a horizontal line projected from the toe of the slope to the face of the building. A retaining wall may be constructed at the base of the slope to achieve the required building clearance.

10.7 Footing Observations

Footing excavations should be observed by LGC to document that they have been excavated into competent bearing soils. The foundation excavations should be observed prior to the placement of forms, reinforcement or concrete. The excavations should be trimmed neat, level and square. Loose, sloughed or moisture-softened soil should be removed prior to concrete placement.

Excavated materials from footing excavations should not be placed in slab-on-ground areas unless the soils are compacted to 90 percent or more of maximum dry density as determined by ASTM D1557.

10.8 Expansive Soil Considerations

The results of laboratory testing indicate that onsite earth materials exhibit an overall expansion potential of **LOW** in accordance with 2016 CBC, Chapter 18. However, expansive soil conditions should be evaluated for the building pads during and at the completion of rough grading to observe and document the actual as-graded conditions. It will be necessary to blend the excavated soil to mitigate the high expansion potential of some of the upper soil. The design and construction details presented herein are intended to provide recommendations for the levels of expansion potential which may be evident at the completion of rough grading. Furthermore, it should be noted that additional slab thickness, footing sizes and/or reinforcement more stringent than the recommendations that follow should be provided as recommended by the project architect or structural engineer.

10.9 Footings/Floor Slabs – Low Expansion Potential

The following are our recommendations where foundation soils exhibit **LOW** expansion potential as classified in accordance with 2016 CBC. However, expansive soil conditions should be evaluated for the building pads during and at the completion of rough grading to observe and document the actual as-graded conditions. For this condition, it is recommended that footings and floors be constructed and reinforced in accordance with the following criteria. However, additional slab thickness, footing sizes and/or reinforcement may be required by the project architect or structural engineer. We recommend using a Plasticity Index of 14 per our Atterberg limits test results (Appendix D).

Footings

- Exterior continuous footings should be founded into compacted engineered fill below the lowest adjacent final grade at minimum depths of 12 inches and 18 inches deep for one-story and two-story construction, respectively. Interior continuous footings may be founded at a depth of 12 inches or greater into compacted engineered fill below the lowest adjacent final grade. Continuous footings should have a minimum width of 12 inches for one-story and 15 inches for two-story structures.
- Continuous footings should be reinforced with two (2) No. 4 bars, one near top and one at bottom.
- Interior isolated pad footings should be 24 inches or more square and founded at a depth of 12 inches or more below the lowest adjacent grade. Footings should be reinforced in accordance with the structural engineer's recommendation.
- Exterior pad footings should be 24 inches square or greater and founded at a depth of 18 inches or more below the lowest adjacent grade; and if isolated, interconnected and connected to the main foundation by in-grade beams. Exterior footings should be reinforced in accordance with the structural engineer's recommendations.

Floor Slabs

- Concrete foundation floor slabs should be 4 inches or more thick and reinforced with No. 3 bars spaced 24 inches or less on-centers, both ways. Slab reinforcement should be supported on concrete chairs so that the desired placement is properly placed per the design engineer.
- Concrete floors should be underlain with a moisture-vapor retarder consisting of a 15-mil thick vapor barrier. Laps within the membrane should be sealed and overlapped 12 inches. Two inches or more of clean sand should be placed above and below the membrane. These recommendations must be confirmed (and/or modified) by the foundation engineer with our concurrence, based upon the performance expectations of the foundation. It is the responsibility of the contractor to ensure that the moisture/vapor barrier systems are placed in accordance with the project plans and specifications, and that the moisture/vapor retarder materials are free of tears and punctures prior to concrete placement. Additional moisture reduction and/or prevention measures may be needed, depending on the performance requirements of future interior floor coverings.
- Garage area floor slabs should be 4 inches thick and should be reinforced in a similar manner as concrete floor slabs. Garage area floor slabs should also be placed separately from adjacent wall footings with a positive separation maintained with 3/8-inch minimum felt expansion joint materials and quartered with weakened-plane joints. A 12-inch wide grade beam founded at the same depth as adjacent footings should be provided across garage entrances. The grade beam should be reinforced with a minimum of two No. 4 bars, one top and one bottom.
- Prior to placing concrete, the subgrade soils below all floor slabs should be pre-watered to achieve a moisture content that is equal to 120 percent of the optimum moisture content of the subgrade soils. The moisture content should penetrate to a minimum depth of 18 inches. This will promote uniform curing of the concrete and minimize the development of shrinkage cracks.

10.10 Nonstructural Concrete Flatwork

Concrete flatwork (such as walkways, driveways, patios, bicycle trails, etc.) has a high potential for cracking due to changes in soil volume related to soil-moisture fluctuations. To reduce the potential for excessive cracking and lifting, concrete should be designed in accordance with the minimum guidelines outlined in Table 5. These guidelines will reduce the potential for irregular cracking and promote cracking along construction joints but will not eliminate all cracking or lifting. Thickening the concrete and/or adding additional reinforcement will further reduce cosmetic distress.

TABLE 5
NONSTRUCTURAL CONCRETE FLATWORK FOR LOW EXPANSIVE SOILS

	Private Sidewalks	***Private Drives***	***Patios/Entryways***	***City Sidewalk Curb and Gutters***
Minimum Thickness (in.)	4 (nominal)	4 (full)	4 (full)	City/Agency Standard
Presaturation	Presoak to 18 inches	Presoak to 18 inches	Presoak to 18 inches	City/Agency Standard
Reinforcement	—	No. 3 at 24 inches on center	No. 3 at 24 inches on center	City/Agency Standard
Thickened Edge	—	8″ x 8″	8″ x 8″	City/Agency Standard
Crack Control	Saw cut or deep open tool joint to a minimum of 1/3 the concrete thickness	Saw cut or deep open tool joint to a minimum of 1/3 the concrete thickness	Saw cut or deep open tool joint to a minimum of 1/3 the concrete thickness	City/Agency Standard
Maximum Joint Spacing	5 feet	10 feet or quarter cut whichever is closer	6 feet	City/Agency Standard

11.0 SOIL CORROSIVITY

The National Association of Corrosion Engineers (NACE) defines corrosion as "a deterioration of a substance or its properties because of a reaction with its environment". From a geotechnical viewpoint, the "environment" is the prevailing foundation soils and the "substances" are the reinforced concrete foundations or various buried metallic elements such as rebar, piles, pipes, etc., which are in direct contact with or within close vicinity of the foundation soil.

In general, soil environments that are detrimental to concrete have high concentrations of soluble sulfates. ACI 318R-05, Table 4.3.1 provides specific guidelines for the concrete mix design based on different amount of soluble sulfate content. The minimum amount of chloride ions in the soil environment that are corrosive to steel, either in the form of reinforcement protected by concrete cover, or plain steel substructures such as steel pipes or piles, is 500 ppm per California Test 532 and ACI 318R-05, Table 4.4.1.

The corrosion potential of the onsite materials was evaluated for its effect on steel and concrete. The corrosion potential was evaluated using the results of laboratory tests performed on representative samples obtained during the subsurface exploration. Laboratory testing was performed to evaluate pH, resistivity, chloride content, and soluble sulfate content. Based on the laboratory testing performed, the onsite soils are classified as having a **negligible** sulfate exposure condition in accordance with ACI 318R-05, Table 4.3.1, and **negligible** chloride exposure condition in accordance with ACI 318R-05, Table 4.4.1. Based on laboratory testing of onsite soil, it is also our opinion that onsite soil should be considered to have a **moderate** corrosion risk to buried metals due to the moderate resistivity. Metal piping should be corrosion-protected or consideration should be given to using plastic piping instead of metal or plastic sleeves around the pipe.

Despite the minimum recommendation above, LGC is not a corrosion-engineering firm. Therefore, we recommend that you consult with a competent corrosion engineer and conduct additional testing (if required) to evaluate the actual corrosion potential of the site and to provide recommendations to reduce the corrosion potential with respect to the proposed improvements. The recommendations of the corrosion engineer may supersede the above recommendations.

These recommendations are based on representative samples of the near-surface engineered fill soils. The initiation of grading at the site could blend various soil types and import soils may be used locally. These changes made to the foundation soils could alter sulfate-content levels. Accordingly, it is recommended that additional testing may be performed at the completion of grading.

12.0 RETAINING WALLS

12.1 Lateral Earth Pressures and Retaining Wall Design Parameters

Conventional foundations for retaining walls within properly compacted fill within competent bedrock should be embedded at least 18 inches below lowest adjacent grade. At this depth, an allowable bearing capacity of 1,500 psf may be assumed for retaining walls founded in competent compacted fill.

The following lateral earth pressures are recommended for retaining walls that may be proposed. The recommended lateral pressures for approved onsite soils or import material (with an expansion index of **20** or less and phi angle of internal friction of at least **30** degrees), for level or sloping backfill are presented in Table 6. **Onsite fill soil with an expansion index of greater than 20 should not be used as backfill due to the expansive nature.** Onsite soil should be screened of rocks and other material over 3 inches in diameter.

TABLE 6
LATERAL EARTH PRESSURES

CONDITIONS	***EQUIVALENT FLUID WEIGHT (pcf)***			
	Level Backfill (up to 6 feet)	***Level Backfill Dynamic (>6 feet to10 feet)***	***2:1 Backfill Ascending (up to 6 feet)***	***2:1 Backfill Ascending-Dynamic (>6 feet to 10 feet)***
Active	45	45	80	55
At-Rest	70	70	100	95
Seismic	0	45	0	95
Passive	250	250	120	120

Notes:
1. Applicable to retaining walls only.
2. Active force applied a 1/3 wall height.
3. Seismic force applied to at 1/2 to 3/5 wall height.
4. Lateral pressure acts normally to vertical stem.

For sliding resistance, the friction coefficient of 0.35 may be used at the concrete and soil interface. Wall footings should be designed in accordance with structural considerations.

Restrained structural walls should include design for at rest conditions, if applicable. The magnitude of those pressures depends on the amount of deformation that the wall can yield under load. If the wall can yield enough to mobilize the full shear strength of the soil, it can be designed for "active" pressure. If the wall cannot yield under the applied load, the shear strength of the retained soil cannot be mobilized and the earth pressure will be higher. Such walls should be designed for "at-rest" conditions.

The equivalent fluid pressure values assume free-draining conditions and a soil expansion index of 20 or less. If conditions other than those assumed above are anticipated, revised equivalent fluid pressure values should be provided on an individual-case basis by the geotechnical engineer.

Surcharge loading effects from the adjacent structures should be evaluated by the geotechnical and structural engineers.

12.2 Footing Embedments

The base of retaining wall footings constructed on level ground may be founded at a depth of 12 inches or more below the lowest adjacent final grade. Where retaining walls are proposed on or within 15 feet from the top of an adjacent descending fill slope, the footings should be deepened such that a minimum horizontal clearance of H/3 (one-third the slope height) is maintained between the outside bottom edges of the footings and the face of the slope but not to exceed 15 feet or be less than 5 feet. The above recommended footing setbacks are preliminary and may be revised based on site-specific soil conditions. Footing or pier excavations should be observed by the project geotechnical representative to document that the footing trenches have been excavated into competent bearing soils and to the embedments recommended above. These observations should be performed prior to placing forms or reinforcing steel.

12.3 Drainage

All retaining wall structures should be provided with appropriate drainage and appropriately waterproofed. The outlet pipe should be sloped to drain to a suitable outlet. It should be noted that that recommended subdrains does not provide protection against seepage through the face of the wall and/or efflorescence. If such seepage or efflorescence is undesirable, retaining walls should be waterproofed to reduce this potential.

Weep holes or open vertical masonry joints should be provided in retaining walls 3 feet or less in height to reduce the likelihood of entrapment of water in the backfill. Weep holes, if used, should be 3 inches or more in diameter and provided at intervals of 6 feet or less along the wall. Open vertical masonry joints, if used, should be provided at 32-inch or less intervals. A continuous gravel fill, 12 inches by 12 inches, should be placed behind the weep holes or open masonry joints. The gravel should be wrapped in filter fabric to reduce infiltration of fines and subsequent clogging of the gravel. Filter fabric may consist of Mirafi 140N or equivalent.

In lieu of weep holes or open joints, for retaining walls less than 3 feet, a perforated pipe and gravel subdrain may be used. Perforated pipe should consist of 4-inch or more diameter PVC Schedule 40 or ABS SDR-35, with the perforations laid down. The pipe should be embedded in 1.5 cubic feet per foot of 0.75 or 1.5-inch open graded gravel wrapped in filter fabric. Filter fabric may consist of Mirafi 140N equivalent.

Retaining walls greater than 3 feet high should be provided with a continuous backdrain for the full height of the wall. This drain could consist of geosynthetic drainage composite, such as Miradrain 6000 or equivalent, or a permeable drain material, placed against the entire backside of the wall. If a permeable drain material is used, the backdrain should be 1 or more feet thick. Caltrans Class II permeable material or open graded gravel or crushed stone (described above) may be used as permeable drain material. If gravel or crushed stone is used, it should have less than 5 percent material passing the No. 200 sieve. The drain should be separated from the backfill with a geofabric. The upper 1 foot of the backdrain should be covered with compacted fill. A drainage pipe consisting of 4-inch diameter perforated pipe (described above) surrounded by 1 cubic foot per foot of gravel or crushed rock wrapped in a filter fabric should be provided along the back of the wall. The pipe should be placed with perforations down, sloped at 2 percent or more and discharge to an appropriate outlet through a solid pipe. The pipe should outlet away from structures and slopes. The outside portions of retaining walls supporting backfill should be coated with an approved waterproofing compound to inhibit infiltration of moisture through the walls.

12.4 Temporary Excavations

Retaining walls, if any are proposed, should be constructed and backfilled as soon as possible after backcut excavations are constructed. Prolonged exposure of backcut slopes may result in some localized slope instability. To facilitate retaining wall construction, the lower 5 feet of temporary slopes may be cut vertical and the upper portions exceeding a height of 5 feet should be cut back at a gradient of 1:1 (h:v) or flatter for the duration of construction. However, temporary slopes should be observed by LGC for evidence of potential instability. Depending on the results of these observations, flatter slopes may be necessary. The potential effects of various parameters such as weather, heavy equipment travel, storage near the tops of the temporary excavations and construction scheduling should also be considered in the stability of temporary slopes. Water should not be permitted to drain away from the slope. Surcharges, due to equipment, spoil piles, etc., should not be allowed within 10 feet of the top of the slope.

All excavations should be made in accordance with Cal/OSHA. Excavation safety is the sole responsibility of the contractor.

12.5 Retaining Wall Backfill

Any retaining wall backfill soils (with an expansion index of 20 or less) should be placed in 6-inch to 8-inch loose lifts, watered or air-dried as necessary to achieve near optimum moisture conditions and compacted to at least 90 percent relative density (based on ASTM Test Methods D2922 and D3017).

13.0 PRELIMINARY PAVEMENT DESIGN

Structural pavement section design recommendations presented herein are based on a soil sample from our preliminary geotechnical investigation, as well as a soil sample from our previous preliminary geotechnical investigation for the adjoining northeast site. However, it should be understood that the soil material exposed during grading may differ from the materials sampled and tested during this investigation. Therefore, these preliminary pavement recommendations are subject to verification and possible revision based on any revised Traffic Indices (TI's), as well as sampling and testing of subgrade soils that exist after rough grading.

For planning and design purposes, we have prepared the following preliminary pavement sections based on R-value testing results. The R-value is 68 for a soil sample collected on the site, which has been used in Table 7 below for preliminary pavement section recommendations. Table 7 presents recommended preliminary pavement designs for a TI of 5.0 for Driveways & Parking Lots (Local Roads) and a TI of 6.0 for Residential Collectors, based on the design R-value of 68 and City of Murrieta pavement sections.

TABLE 7
PRELIMINARY PAVEMENT DESIGN

AREA	ASSUMED TRAFFIC INDEX	DESIGN (AVERAGE) R-VALUE	ASPHALTIC CONCRETE (AC) (inches)	AGGREGATE BASE (AB) (inches)
Driveways & Parking Lots (Local Roads)	5.0	68	3.0	6.0
Residential Collectors	6.0	68	4.0	6.0

Subgrade soil immediately below the aggregate base (base) should be compacted to a minimum of 95 percent relative compaction based on ASTM Test Method D1557 to a minimum depth of 12 inches. Final subgrade compaction should be performed prior to placing base or asphaltic concrete and after all utility trench backfills have been compacted and tested.

Base materials should consist of crushed aggregate base conforming to Section 200-2 of Greenbook. The upper 12 inches of all aggregate base materials should be compacted to at least 95 percent of the laboratory maximum dry density determined in accordance with ASTM D1557.

Our preliminary pavement recommendations should be considered as minimum, per City of Murrieta requirements.

14.0 PLAN REVIEWS AND CONSTRUCTION SERVICES

This report has been prepared for the exclusive use of **Lyles Diversified, Inc.** to assist the project engineer and architect in the design of the proposed office building and workshop development. It is recommended that LGC be engaged to review the rough grading plans, storm-drain/storm water mitigation plans, structural plans and the final design drawings and specifications prior to construction. This is to document that the recommendations contained in this report have been properly interpreted are incorporated into the project specifications. LGC's review of the rough grading plan may indicate that additional subsurface exploration, laboratory testing and analysis should be performed to address areas of concern. If LGC is not accorded the opportunity to review these documents, we can take no responsibility for misinterpretation of our recommendations.

We recommend that LGC be retained to provide geotechnical engineering services during both the rough grading and construction phases of the work. This is to document compliance with the design, specifications or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

If the project plans change significantly (e.g., building loads or type of structures), we should be retained to review our original design recommendations and their applicability to the revised construction. If conditions are encountered during construction that appears to be different than those indicated in this report, this office should be notified immediately. Design and construction revisions may be required.

15.0 LIMITATIONS

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable engineers and geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report. The subsurface observations and information contained herein are believed representative of the entire project; however, soil and geologic conditions revealed by excavation may be different than our preliminary findings. If this occurs, the changed conditions must be evaluated by the project geotechnical engineer and engineering geologist and design(s) adjusted as required or alternate design(s) recommended.

The findings of this report may be modified upon performing future geotechnical/geologic evaluations. However, changes in the conditions of a property can and do occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties.

This report is issued with the understanding that it is the responsibility of the owner, or of his/her representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and/or project engineer and incorporated into the plans, and the necessary steps are taken to see that the contractor and/or subcontractor properly implements the recommendations in the field. The contractor and/or subcontractor should notify the owner if they consider any of the recommendations presented herein to be unsafe.

The conclusions and opinions contained in this report are based on the results of the described geotechnical evaluations and represent our professional judgment. The findings, conclusions and recommendations contained in this report are to be considered tentative only and subject to confirmation by LGC during the construction process. Without this confirmation, this report is to be considered incomplete and LGC will not assume any responsibility for its use.

The conclusions and opinions contained in this report are valid up to a period of 1 year from the date of this report or adopted changes within the California Building Code, whichever occurs first. Changes in the conditions of a site can and do occur with the passage of time, whether those be because of natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate codes or standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside LGC's control. Therefore, if any of the above-mentioned situations occur, an update of this report must be completed.

This report has not been prepared for use by parties or projects other than those named or designed above. It may not contain sufficient information for other parties or other purposes.

The opportunity to be of service is appreciated. Should you have any questions regarding the content of this report, or should you require additional information, please do not hesitate to contact this office at your earliest convenience.

APPENDIX A

REFERENCES

APPENDIX A

References

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APPENDIX B

GEOTECHNICAL INVESTIGATION
GLOBAL GEO-ENGINEERING, INC.

GLOBAL GEO-ENGINEERING, INC.

November 15, 2017
Project 7355-04

Guardian Real Estate Services, Inc.
41606 Date Street, Suite 203A
Murrieta, California 92562

Attention: Mr. Darrell Clendenen

Subject: Geotechnical Investigation
Proposed Covered Outdoor Storage Facility
26501 Madison Avenue
Murrieta, California

References: *See Appendix A*

Dear Mr. Clendenen:

1. INTRODUCTION

a) In accordance with your request, we have conducted a geotechnical investigation for the proposed improvements to be constructed on the above referenced property located in Murrieta, California.

b) We reviewed the preliminary Site Plan *Sheet A-1.0* provided to us. We understand covered outdoor storage facility is proposed to be constructed on a 4.38 acre vacant lot. The exact configuration of which has not yet been determined. CMU block walls are also planned to be constructed on the northern area of the property. The entire lot will be covered with Asphalt Concrete (AC) paving. Madison Avenue will also be extended along the northeastern side of the site.

c) We have reviewed a preliminary earthwork estimate plan prepared for the project site. A 4- to 19-foot high, 2:1 (horizontal:vertical) gradient cut slope is planned along the northwestern side of the property. The remaining area of the site is proposed to be graded to generally descend at a 2.71 percent gradient toward the southwestern corner of the property. The grading will consist of cuts and fills to achieve the proposed grades.

3 Corporate Park, Suite 270, Irvine, California 92606
Office (949) 221-0900 Fax (949) 221-0091
e-mail: global@globalgeo.net

2. PURPOSE

The purpose of our investigation was to obtain and analyze subsurface information in order to provide site-specific recommendations pertaining to the following:

a) grading;

b) processing of soils;

c) foundation types;

d) foundation depths;

e) bearing capacity;

f) expansivity;

g) sulphate content and cement type;

h) shrinkage factor;

i) settlement;

j) seismicity.

3. SCOPE

The scope of services we provided was as follows:

a) Preliminary planning and evaluations, and review of geotechnical reports related to the project site and nearby surrounding area *(see References - Appendix A)*;

b) Field exploration, consisting of drilling nine exploratory borings to a maximum depth of 18.5 feet below existing grade. One of the borings (Boring P-1) was used to conduct a percolation test;

c) Logging of the borings by our Engineering Geologist;

d) Obtaining in-situ and bulk samples for classification and laboratory testing;

e) Laboratory testing of selected samples considered representative of site conditions, in order to derive relevant engineering properties;

f) Geologic and engineering analyses of the field and laboratory data;

g) Preparation of a report presenting our findings, conclusions and recommendations.

4. FIELD EXPLORATION AND LABORATORY TESTING

The field exploration program is given in *Appendix B*, which includes the Logs of Borings. The results of the laboratory testing are included in *Appendix C*.

5. SITE DESCRIPTION

5.1 Location

a) The 4.38 acre site is located just southwest of the intersection of Madison Avenue and Golden Gate Circle in the city of Murrieta, California.

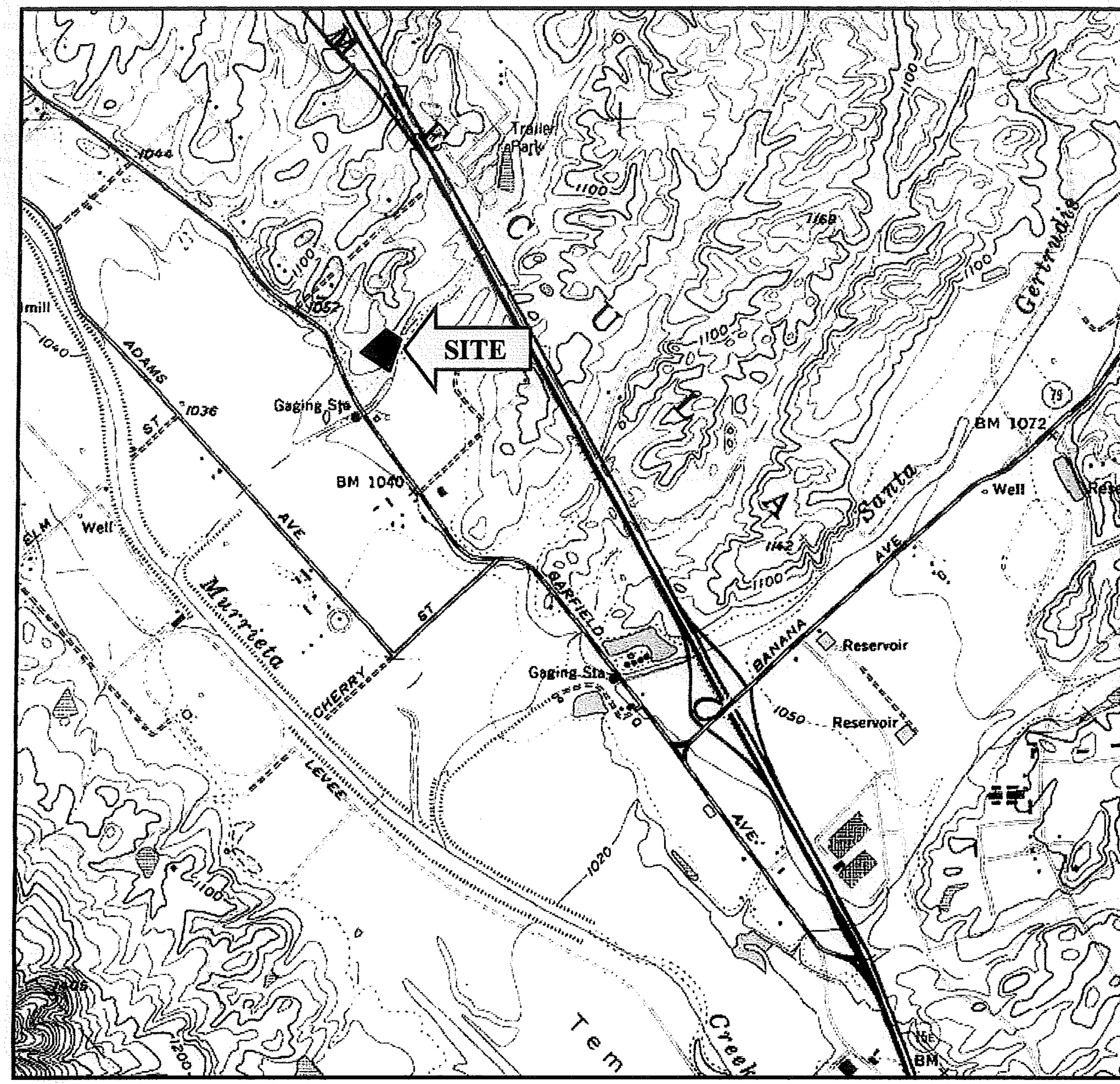
b) The approximate site location is shown on the *Location Map, Figure 1*.

5.2 Surface Conditions

a) The ground surface within the northern part of the site generally slopes to the south, southwest and southeast at gradients ranging from 2:1 (horizontal:vertical) to 6:1 (h:v). A relatively level plateau exists within the central part of the northeast-lying property line. The ground surface within the southern part of the property generally descends to the south/southeast at a 3 to 4 percent gradient. A creek channel (Warm Springs Creek) crosses through the eastern corner of the property. Ground surface elevations range from approximately 1089 feet above Mean Sea Level (MSL) along the northwestern edge of the site to about 1038 feet above MSL along the bottom of the creek channel.

b) Surface drainage consists of sheet flow runoff of incident rainfall water derived primarily within the property boundaries and adjacent properties. The nearest primary drainage feature is Warm Springs Creek, located along the eastern edge of the property.

LOCATION MAP



BASE MAP: USGS 7.5-Minute Topographic Map,
Murrieta Quadrangle, 1979

2000 0 2000 4000

SCALE FEET

NORTH

GLOBAL GEO-ENGINEERING, INC.

GEOLOGIC AND SOILS ENGINEERING IRVINE, CALIFORNIA

26501 Madison Avenue
Murrieta, California

Date: November 2017

Project No.: 7355-04

Figure No: 1

5.3 Geology

5.3.1 Regional Geologic Setting

a) The project site is situated in the southern Temescal Valley area of Riverside County, which forms part of the Peninsular Ranges Geomorphic Province of California. Geologic structures within this province are characterized by a northwest-trending topographic range that terminates directly against the Transverse Ranges to the north. The inland portions of the province include several high mountain ranges, underlain by igneous, metasedimentary and metavolcanic rock of the Paleozoic and Mesozoic age.

b) The coastal portion is defined by clastic marine and non-marine terraces of the upper Cretaceous, Tertiary, and Quaternary age. Structurally, the province is regarded as an uplifted and westward tilted range, which has been faulted and broken up into several smaller sub-parallel blocks. The Peninsular Ranges province is both bounded and transected by several major fault zones. Principal faults include the San Andreas, San Jacinto, Newport-Inglewood and the Whittier-Elsinore Fault Zones.

5.3.2 Local Geologic Setting

In general, the project site is underlain by Holocene-age alluvium and Pleistocene-age SANDSTONE and SILTSTONE, belonging to the Pauba Formation.

5.4 Subsurface Conditions

The subsurface conditions, as encountered in our explorations, are described in the following sections. Our boring logs are enclosed as *Figures B-2* through *B-10*. The boring locations are shown on our *Geotechnical Plan, Plate 1*. The subsurface conditions are also depicted on *Geotechnical Cross Section, Plate 2*

5.4.1 Alluvium

a) Holocene-age alluvial deposits were encountered in Borings B-1, B-3, B-4 and P-1.

b) The alluvium was found to consist of Sandy to Clayey SILT and Silty SAND

c) The Sandy to Clayey SILT was generally found to be grayish brown to olive brown, slightly moist to moist, soft to medium stiff and porous.

d) The Silty SAND was generally observed to be fine grained, light olive brown to dark brown and loose to medium dense.

e) The depths of alluvium encountered in our excavations were found to range from 5 feet in Boring B-4 to 7 feet in Boring B-1.

5.4.2 Pauba Formation

a) Pleistocene-age bedrock, belonging to the Pauba Formation, was encountered in all of our borings to the maximum depths excavated.

b) The bedrock encountered in our excavations was generally observed to consist of fine to coarse grained, yellowish brown to olive brown, and medium dense SANDSTONE/Silty SANDSTONE with olive brown and medium stiff to stiff Sandy SILTSTONE.

5.4.3 Groundwater

a) No free groundwater or seepage zones were encountered in our exploratory borings.

b) In direct proximity of the property, shallow ground water is not expected to be present, due to the relatively impermeable nature of the underlying Pauba Formation.

c) Intermittent water migrating through fracture zones as seepage may, however, occur within the underlying formation. The amount of seepage is primarily dependent on seasonal precipitation and irrigation use from the higher elevated properties.

6. SEISMICITY

6.1 General

a) The property is located in the general proximity of several active and potentially active faults, which is typical for sites in the Southern California region. Earthquakes occurring on active faults within a 70-mile radius are capable of generating ground shaking of engineering significance to the proposed construction.

b) In Southern California, most of the seismic damage to manmade structures results from ground shaking and, to a lesser degree, from liquefaction and ground rupture caused by earthquakes along active fault zones. In general, the greater the magnitude of the earthquake, the greater is the potential damage.

6.2 Ground Surface Rupture

a) The project site is not located within a State of California delineated Earthquake Fault Zone (previously referred to as the Alquist-Priolo Special Studies Zone).

b) The closest known active fault is the Wildomar Fault, mapped to be located at a distance of about 800 feet southwest of the project site.

c) Other known active faults include the Elsinore Fault (Glen Ivy Segment) and the San Jacinto Fault, located at distances of about 12.4 miles and 20.6 miles, respectively, from the subject property.

d) Due to the distance of the closest active fault to the site, ground rupture is not considered a significant hazard at the site.

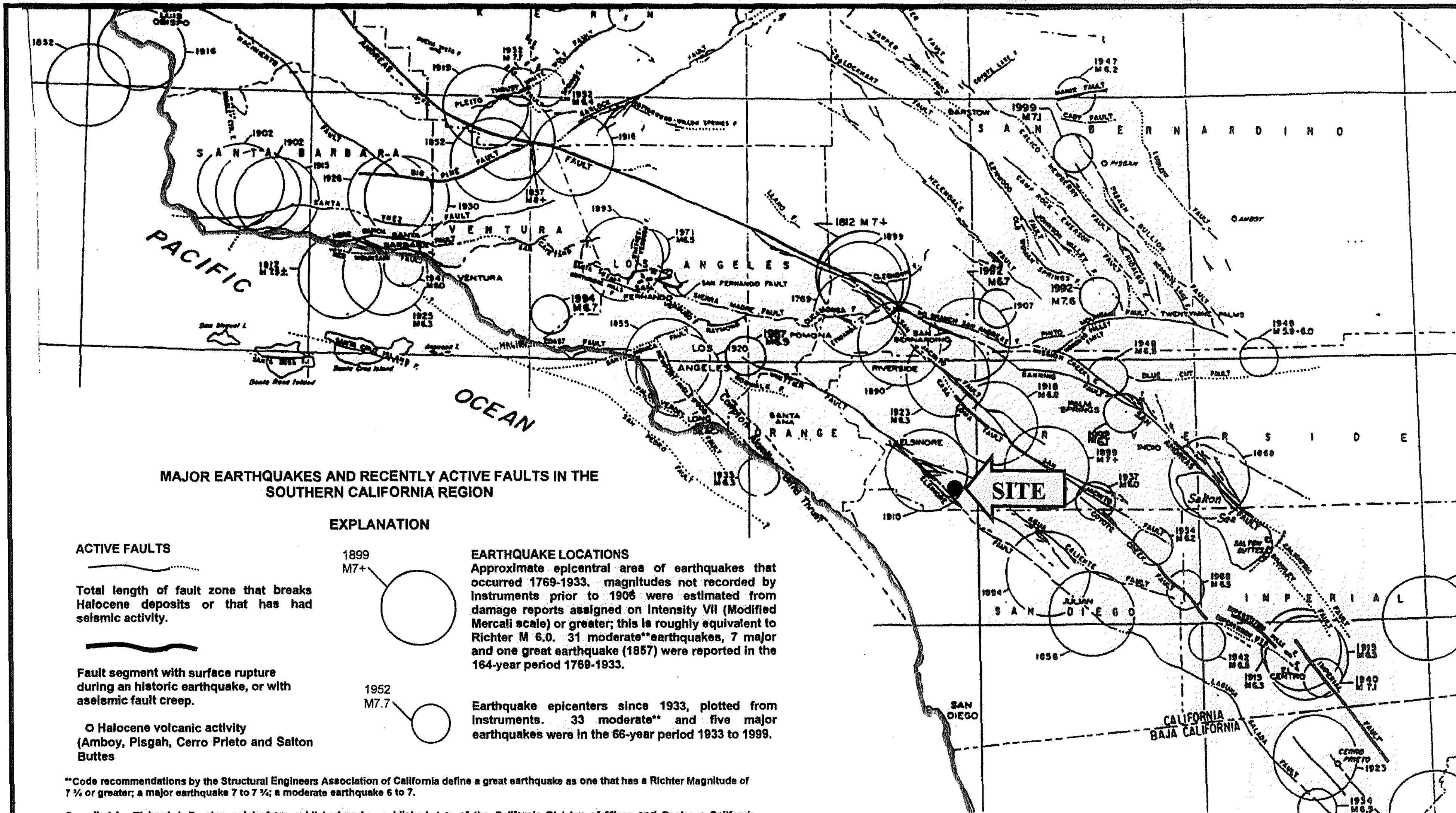
6.3 Ground Shaking

a) We utilized the *U.S. Seismic Design Maps* internet program provided by the U.S. Geological Survey to calculate the peak ground acceleration (PGA) at the project site location. The PGA at the subject property resulted to be 0.842g.

b) *Figure 2* shows the geographical relationships among the site locations, nearby faults and the epicenters of significant occurrences. From the seismic history of the region and proximity, the Wildomar Fault has the greatest potential for causing earthquake damage related to ground shaking at this site.

6.4 Liquefaction

a) Liquefaction is the phenomenon where saturated soils develop high pore water pressures during seismic shaking and behave like a fluid.



MAJOR EARTHQUAKES AND RECENTLY ACTIVE FAULTS IN THE SOUTHERN CALIFORNIA REGION

EXPLANATION

ACTIVE FAULTS

Total length of fault zone that breaks Halocene deposits or that has had seismic activity.

Fault segment with surface rupture during an historic earthquake, or with aseismic fault creep.

O Halocene volcanic activity (Amboy, Pisgah, Cerro Prieto and Salton Buttes

1899 M7+

EARTHQUAKE LOCATIONS
Approximate epicentral area of earthquakes that occurred 1769-1933. magnitudes not recorded by instruments prior to 1906 were estimated from damage reports assigned on Intensity VII (Modified Mercali scale) or greater; this is roughly equivalent to Richter M 6.0. 31 moderate** earthquakes, 7 major and one great earthquake (1857) were reported in the 164-year period 1769-1933.

1952 M7.7

Earthquake epicenters since 1933, plotted from instruments. 33 moderate** and five major earthquakes were in the 66-year period 1933 to 1999.

**Code recommendations by the Structural Engineers Association of California define a great earthquake as one that has a Richter Magnitude of 7 ¾ or greater; a major earthquake 7 to 7 ¾; a moderate earthquake 6 to 7.

Compiled by Richard J. Proctor mainly from published and unpublished data of the *California Division of Mines and Geology; California Department of Water Resources Bulletin 116-2* (1964); selections from bulletins of the *Geological* and *Seismological Societies of America*; from C.F. Richter, *Elementary Seismology* (1958); and the *National Atlas*, p. 66, and from Working Group on California Earthquake Probabilities- SSA Bulletin V 85.

GLOBAL GEO-ENGINEERING, INC. GEOLOGIC AND SOILS ENGINEERING IRVINE, CALIFORNIA	26501 Madison Avenue Murrieta, California	
	Date: November 2017	**Figure No:**
	Project No: 7355-04	2

b) The eastern corner of the property is located within a State of California delineated *Seismic Hazard Zone* for liquefaction (along the alignment of Warm Springs Creek). The proposed development, however, does not encroach into the delineated liquefaction zone. The site is underlain by shallow bedrock. The ground water is not anticipated due to the impermeable nature of the bedrock. The potential for liquefaction within the proposed development area is considered to be low.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 General

a) It is our opinion that the site will be suitable for the proposed development from a geotechnical aspect, assuming that our recommendations are incorporated in the project plan designs and specifications, and are implemented during construction.

b) We are of the opinion that the proposed lightly loaded structures may be supported on spread footings founded on the competent native material or compacted fill.

c) We are also of the opinion that with due and reasonable precautions, the required grading will not endanger adjacent property nor will grading be affected adversely by adjoining property.

d) The design recommendations in the report should be reviewed during the grading phase when soil conditions in the excavations become exposed.

e) The final grading plans and foundation plans/design loads should be reviewed by the Geotechnical Engineer.

7.2 Grading

7.2.1 Processing of On-Site Soils

a) The site is proposed to be graded by cutting and filling. Prior to placing the fill, any unsuitable soils exposed at the bottom of the excavation should be removed to the competent soils.

b) It is recommended that for any proposed structure, the entire footings should be embedded in to one type of material.

c) No overexcavation below any foundation is recommended provided the footings are excavated entirely in the competent native soils or entirely in the compacted fill soils.

d) In the event a transition is encountered exposing two different types of materials, the material should be overexcavated to provide at least one foot of compacted fill below the bottom of the footings.

e) The subgrade soils below the asphalt paving should be overexcavated to a depth of one foot. The excavation may be backfilled using the onsite soils.

f) Prior to placing any fill, the subgrade soils should be scarified to a depth 6 to 8 inches or to the depth as recommended by the geotechnical engineer. The exposed bottom should be approved by a geotechnical engineer.

g) Any loosening of reworked or native material, consequent to the passage of construction traffic, weathering, etc., should be made re-rolled to further construction.

h) The depths of overexcavation, if any, should be reviewed by the Geotechnical Engineer during construction. Any surface or subsurface obstructions, or any variation of site materials or conditions encountered during grading should be brought immediately to the attention of the Geotechnical Engineer for proper exposure, removal or processing, as directed. No underground obstructions or facilities should remain in any structural areas. Depressions and/or cavities created as a result of the removal of obstructions should be backfilled properly with suitable materials, and compacted.

7.2.2 Material Selection

After the site has been stripped of any debris, vegetation and organic soils, excavated on-site soils are considered satisfactory for reuse in the construction of on-site fills, with the following provisions:

a) No organic contents are permitted in the fill;

b) Large size rocks or concrete pieces greater than 8 inches in diameter should not be incorporated in compacted fill;

c) Rocks or concrete pieces greater than 4 inches in diameter should not be incorporated in compacted fill to within 1 foot of the underside of the footings and slabs.

7.2.3 Compaction Requirements

a) Reworking/compaction shall include significant moisture conditioning as needed to bring the soils to slightly above the optimum moisture content. All reworked soils and structural fills should be densified to achieve at least **90 percent relative compaction** with reference to laboratory compaction standard. The optimum moisture content and maximum dry density should be determined in the laboratory in accordance with ASTM Test Designation D1557.

b) Fill should be compacted in lifts not exceeding 8 inches (loose).

7.2.4 Excavating Conditions

a) Excavation of on-site materials may be accomplished with standard earthmoving or trenching equipment.

b) Groundwater was not encountered to the depths explored. Dewatering is not anticipated.

7.2.5 Shrinkage

For preliminary earthwork calculation, an average shrinkage factor of 10 percent is recommended for the native soils (this does not include handling losses).

7.2.6 Expansion Potential

a) Based upon visual observation, the expansivity of the site soils is considered to be *Low*.

b) The soil expansion potential for subgrade soils should be determined during the final stages of rough grading for the area of proposed slab-on-grade.

7.2.7 Sulphate Content

a) The sulphate content of a representative sample of the subgrade soil was less than 0.1 percent. The sulphate exposure is considered *negligible* in accordance with the building code.

b) The fill materials should be tested for their sulphate content during the final stage of rough grading.

7.2.8 Utility Trenching

a) The walls of temporary construction trenches in fill should stand nearly vertical, with only minor sloughing, provided the total depth does not exceed 3 feet (approximately). Shoring of excavation walls or flattening of slopes may be required, if greater depths are necessary.

b) Trenches should be located so as not to impair the bearing capacity or to cause settlement under foundations. As a guide, trenches should be clear of a 45-degree plane, extending outward and downward from the edge of foundations. Shoring should comply with Cal-OSHA regulations.

c) Existing soils may be utilized for trenching backfill, provided they are free of organic materials.

d) All work associated with trench shoring must conform to the state and federal safety codes.

7.2.9 Surface Drainage Provisions

Positive surface gradients should be provided adjacent to the buildings to direct surface water run-off away from structural foundations and to suitable discharge facilities.

7.2.10 Grading Control

All grading and earthwork should be performed under the observation of a Geotechnical Engineer in order to achieve proper subgrade preparation, selection of satisfactory materials, placement and compaction of structural fill. Sufficient notification prior to stripping and earthwork construction is essential to make certain that the work will be adequately observed and tested.

7.3 Slab-on-Grade (if any)

a) Concrete floor slabs may be founded on the reworked existing soils or compacted fill.

b) The slab-on-grade should be underlain by 4-inch thick SAND. A plastic vapor barrier should be placed below the SAND.

c) It is recommended that #3 bars on 18-inch center, both ways, or equivalent be provided as minimum reinforcement in slabs-on-grade. Joints should be provided and slabs should be at least 4 inches thick.

d) The FFL should be at least 6 inches above highest adjacent grade.

e) The subgrade should be kept moist prior to the concrete pour.

7.4 Spread Foundations

The proposed structures can be founded on shallow spread footings supported by the competent native materials or compacted fill soils. The minimum criteria presented below should be adopted:

7.4.1 Dimensions/Embedment Depths

	Minimum Width (ft)	**Minimum Embedment Below Lowest Finished Surface (ft)**
Square Column Footings to 50 kip	–	2.0

7.4.2 Allowable Bearing Capacity

Embedment Depth (ft)	**Allowable Bearing Capacity (lb/ft^2)**
1.0	1,600

(Notes:

- The allowable bearing capacity may be increased by 600 $lb/ft^2$for each additional foot increase in depth or by 200 lb/ft^2 for each additional foot increase in width, to a maximum value of 3,500 $lb/ft^{2;}$
- These values may be increased by one-third in the case of short-duration loads, such as induced by wind or seismic forces;
- At least 4x#4 bars should be provided in wall footings, two on top and two at the bottom;
- Footings for any structures adjacent to the descending slope should be sited such that horizontal distance from the lower outer edge of the footings to the competent slope should be 1/3 x the slope height; minimum 10 feet and need not exceed 40 feet;

- In the event that footings are founded in structural fills consisting of imported materials, the allowable bearing capacities will depend on the type of these materials, and should be re-evaluated;
- Bearing capacities should be re-evaluated when loads have been obtained and footings sized during the preliminary design;
- Planter areas should not be sited adjacent to walls;
- Footing excavations should be observed by the Geotechnical Engineer;
- Footing excavations should be kept moist prior to the concrete pour;
- It should be insured that the embedment depths do not become reduced or adversely affected by erosion, softening, planting, digging, etc.)

7.4.3 Settlements

Total and differential settlements under spread footings are expected to be within tolerable limits and are not expected to exceed 1 and ¾ inches over a horizontal distance of 40 feet, respectively.

7.5 Lateral Forces

a) The following lateral pressures are recommended for the design of retaining structures.

Lateral Force	**Soil Profile**	**Pressure (lb/ft²/ft depth)**	
		Unrestrained Wall	**Rigidly Supported Wall**
Active Pressure	Level	34	-
At-Rest Pressure	Level	-	56
Passive Resistance (ignore upper 1.5 ft.)	Level	275	-

b) Friction coefficient: 0.37 (includes a Factor of Safety of 1.5). While combining friction with passive resistance, reduce passive by 1/3.

c) These values apply to the existing soil, and to compacted backfill generated from in-situ material. Imported material should be evaluated separately. It is recommended that where feasible, imported granular backfill be utilized, for a width equal to approximately one-quarter the wall height, and not less than 1.5 feet.

d) Backfill should be placed under engineering control.

e) Subdrains should be provided behind retaining walls. The subdrain should consist of 4-inch perforated (holes facing down) Schedule 40 or SDR-35 pipe, embedded in at least 1 cubic ft/ft of gravel, wrapped in a geofabric, such as Mirafi 140N.

7.6 Seismic Coefficients

The table on the following page provides seismic design parameter values from 2015 NEHRP Recommended Seismic Provisions which are being adopted into 2016 ASCE 7 Standard and the 2018 International Building Code.

7.7 Slopes

a) Any fill slopes, no steeper than 2: (horizontal:vertical) should be overbuilt and cut back to design profiles, so as to achieve proper compaction on the slope faces. Overbuilding is usually on the order of 2 to 4 feet, depending on the soil, equipment, etc. Compaction efforts may be achieved by backrolling and gridrolling the slope as fill progresses, instead of overbuilding. Whatever means or widths of overbuilding are adopted, it should be ensured that the slopes are compacted to a minimum 90 percent relative compaction at the finished slope surface.

ITEM	VALUE
Site Longitude (Decimal-degrees)	-117.1769
Site Latitude (Decimal-degrees)	33.5346
Site Class	D
Seismic Design Category	D
Mapped Spectral Response Acceleration-Short Period (0.2 Sec) - S_S	1.577
Mapped Spectral Response Acceleration-1 Second Period – S_1	0.590
Short Period Site Coefficient-F_a	1.200
Long Period Site Coefficient F_v	1.710
Adjusted Spectral Response Acceleration @ 0.2 Sec. Period (Sms)	1.892
Adjusted Spectral Response Acceleration @ 1Sec.Period (S_{m1})	1.008
Design Spectral Response Acceleration @ 0.2 Sec. Period (S_{Ds})	1.261
Design Spectral Response Acceleration @ 1-Sec. Period (S_{D1})	0.672

b) The proposed fill slopes should be properly benched and keyed. Keys, in general, should be constructed at a minimum of 12 feet wide and 2 to 3 feet deep with the bottom inclined away from the toe of the slope at 2 percent. The proposed fill should be interlocked (benched) into competent material. (Typical benching dimensions: 5 to 10 feet wide x 4 feet high.)

c) Subdrains must be provided in all keyway excavations. Subdrain pipe shall consist of perforated, 4-inch diameter PVC, Schedule 40 or SDR-35, embedded in gravel rock and wrapped in Mirafi 140N (or equivalent). All subdrain shall be inspected prior to covering with the fabric and rock.

d) The cut slopes should be cut to the proposed grades no steeper than 2:1 (horizontal:vertical). The cut should be observed by an engineering geologist to determine the need of any stabilization to reduce the potential for any surficial instability.

7.8 Pavement

7.8.1 Asphalt Pavement Section

a) Based on Traffic Indices (T.I.) and on the anticipated "R"-Value of 42, the following tentative structural pavement sections are recommended.

Location	**T.I.**	**Asphaltic Concrete (inches)**	**Aggregate Base (inches)**
Parking	5.0	3	4
Access Road – Light Traffic	6.0	3	6
Access Road – Heavy Traffic	7.0	4	7

b) Appropriate traffic index should be selected based on the traffic count.

c) At the conclusion of grading operations, the subgrade soils should be tested to verify the R-Value.

7.8.2 Subgrade Preparation

All pavement areas shall be inspected, tested for compaction requirements, reworked where required and approved immediately prior to the placement of aggregate base. Subgrade soils within the upper 12 inches of finished grade shall be moisture-conditioned where necessary, shall be compacted to at least 90 percent relative compaction per ASTM D1557, and shall be free of any loose or soft areas.

7.8.3 Base Preparation

Unless otherwise specified, the base shall consist of Class II ¾-inch aggregate base or Crushed Miscellaneous Base (CMB). The base shall be compacted to a minimum of 95 percent relative compaction in accordance with the procedures described in ASTM Test Method D1557.

7.8 Soil Corrosion Potential

a) Soil Corrosion potential for metal and concrete was estimated by performing water-soluble sulfate, chloride, pH, and electrical resistivity tests during this investigation.

b) Electrical resistivity is a measure of soil resistance to the flow of corrosion currents. Corrosion currents are generally high in low resistivity soils. The electrical resistivity of a soil decreases primarily with an increase in its chemical and moisture contents. A commonly accepted correlation between electrical resistivity and corrosivity for buried ferrous metals is presented below:

Electrical Resistivity, Ohm-cm	Corrosion Potential
Less than 1,000	Severe
1,000-2,000	Corrosive
2,000-10,000	Moderate
Greater than 10,000	Mild

c) Results of electrical resistivity tests indicated a minimum resistivity ranging between 1,400 and 3,952 ohm-cm. Based on this data, it is our opinion that, in general, on-site soils have a *moderate* corrosion potential. This potential should be considered in design of underground metal pipes.

8. LIMITATIONS

a) Soils and bedrock over an area show variations in geological structure, type, strength and other properties from what can be observed sampled and tested from specimens extracted from necessarily limited exploratory borings. Therefore, there are natural limitations inherent in making geologic and soil engineering studies and analyses. Our findings, interpretations, analyses and recommendations are based on observation, laboratory data and our professional experience; and the projections we make are professional judgments conforming to the usual standards of the profession. No other warranty is herein expressed or implied.

b) In the event, that during construction, conditions are exposed which is significantly different from those described in this report, they should be brought to the attention of the Geotechnical Engineer.

c) The recommendations provided in this report are intended to minimize the potential of distress to the structures caused by the subgrade soils. However, it should be noted that certain amount of distress to the existing and proposed improvements of the slab is unavoidable and should be anticipated during the lifetime of the existing and the proposed structures.

The opportunity to be of service is sincerely appreciated. If you have any questions or if we can be of further assistance, please call.

Very truly yours,

GLOBAL GEO-ENGINEERING, INC.

Mohan B. Upasani
Principal Geotechnical Engineer
RGE 2301
(Exp. March 31, 2019)

REGISTERED PROFESSIONAL ENGINEER
MOHAN B. UPASANI
Exp. Date 03/31/19
2301
GEOTECHNICAL
STATE OF CALIFORNIA

Kevin B. Young
Principal Engineering Geologist
CEG 2253
(Exp. October 31, 2019)

CERTIFIED ENGINEERING GEOLOGIST
KEVIN B. YOUNG
No. 2253
Exp. 10-31-19
STATE OF CALIFORNIA

MBU/KBY: fdg

Enclosures:

Location Map	- Figure 1
Seismicity Map	- Figure 2
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References	- Appendix A
Field Exploration	- Appendix B
Unified Soils Classification System	Figure B-1
Logs of Borings	Figures B-2 through B-10
Laboratory Testing	- Appendix C
Geotechnical Plan	- Plate 1
Geotechnical Cross Section	- Plate 2

TERMS AND CONDITIONS OF AUTHORIZATION

Consultant shall serve Client by providing professional counsel and technical advice regarding subsurface conditions consistent with the scope of services agreed-to between the parties. Consultant will use his professional judgment and will perform his services using that degree of care and skill ordinarily exercised under similar circumstances, by reputable foundation engineers and/or engineering geologists practicing in this or similar localities.

- In assisting Client, the Consultant may include or rely on information and drawings prepared by others for the purpose of clarification, reference or bidding; however, by including the same, the Consultant assumes no responsibility for the information shown thereon and Client agrees that Consultant is not responsible for any defects in its services that result from reliance on the information and drawings prepared by others. Consultant shall not be liable for any incorrect advice; judgment or decision based on any inaccurate information furnished by the Client or any third party, and Client will indemnify Consultant against claims, demands, or liability arising out of, or contribute to, by such information.

- Unless otherwise negotiated in writing, Client agrees to limit any and all liability, claim for damages, cost of defense, or expenses to be levied against Consultant on account of design defect, error, omission, or professional negligence to a sum **not to exceed ten thousand dollars or charged fees whichever is less.** Further, Client agrees to notify any construction contractor or subcontractor who may perform work in connection with any design, report, or study prepared by Consultant of such limitation of liability for design defects, errors, omissions, or professional negligence, and require as a condition precedent to their performing the work a like limitation of liability on their part as against the Consultant. In the event the Client fails to obtain a like limitation of liability provision as to design defects, errors, omissions or professional negligence, any liability of the Client and Consultant to such contractor or subcontractor arising out of a negligence shall be allocated between Client and Consultant in such a manner that the aggregate liability of Consultant for such design defects to all parties, including the Client shall **not exceed ten thousand dollars or charged fees whichever is less.** No warranty, expressed or implied of merchantability or fitness, is made or intended in connection with the work to be performed by Consultant or by the proposal for consulting or other services or by the furnishing of oral or written reports or findings made by Consultant.

- The Client agrees, to the fullest extent permitted by law, to indemnify, defend and hold harmless the Consultant, its officers, directors, employees, agents and subconsultants from and against all claims, damages, liabilities or costs, including reasonable attorney's fees and defense costs, of any nature whatsoever arising from or in connection with the Project to the extent that said claims, damages, liabilities or costs arise out of the work, services, or conduct of Client or Client's contractors, subconsultants, or other third party not under Consultant's control. Client further agrees that the duty to defend set forth herein arises immediately and is not contingent on a finding of fault against Client or Client's contractors, subconsultants, or other third parties. Client shall not be obligated under this provision to indemnify Consultant for Consultant's sole negligence or willful misconduct.

- Client shall grant free access to the site for all necessary equipment and personnel and Client shall notify any and all possessors of the project site that Client has granted Consultant free access to the project site at no charge to Consultant unless expressly agreed to otherwise in writing.

- If Client is not the property owner for the subject Project, Client agrees that it will notify the property owner of the terms of this agreement and obtain said property owner's approval to the terms and conditions herein. Should Client fail to obtain the property owner's agreement as required herein, Client agrees to be solely responsible to Consultant for all damages, liabilities, costs, including litigation fees and costs, arising from such failure that exceed that limitation of Consultant's liability herein.

- Client shall locate for Consultant and shall assume responsibility for the accuracy of his representations as to the locations of all underground utilities and installations. Consultant will not be responsible for damage to any such utilities or installation not so located.

- Client and Consultant agree to waive claims against each other for consequential damages arising out of or relating to this agreement. Neither party to this agreement shall assign the contract without the express, written consent of the other party.

- Consultant agrees to cover all open test holes and place a cover to carry a 200-pound load on each hole prior to leaving project site unattended. Consultant agrees that all test holes will be backfilled upon completion of the job. However, Client may request test holes to remain open after completion of Consultants work. In the event Client agrees to pay for all costs associated with covering and backfilling said test holes at a later date, and Client shall indemnify, defend and hold harmless Consultant for all claims, demands and liabilities arising from his request, except for the sole negligence of the Consultant, to the extent permitted by law.

- Consultant shall not be responsible for the general safety on the job or for the work of Client, other contractors and third parties.

- Consultant shall be excused for any delay in completion of the contract caused by acts of God, acts of the Client or Client's agent and/or contractors, inclement weather, labor trouble, acts of public utilities, public bodies, or inspectors, extra work, failure of Client to make payments promptly, or other contingencies unforeseen by Consultant and beyond reasonable control of the Consultant.

- In the event that either party desires to terminate this contract prior to completion of the project, written notification of such intention to terminate must be tendered to the other party. In the event Client notifies Consultant of such intention to terminate Consultant's services prior to completion of the contract, Consultant reserves the right to complete such analysis and records as are necessary to place files in order, to dispose of samples, put equipment in order, and (where considered necessary to protect his professional reputation) to complete a report on the work performed to date. In the event that Consultant incurs cost in Client's termination of this Agreement, a termination charge to cover such cost shall be paid by Client.

- If the Client is a corporation, the individual or individuals who sign or initial this Contract, on behalf of the Client, guarantee that Client will perform its duties under this Contract. The individual or individuals so signing or initialing this Contract warrant that they are duly authorized agents of the Client.

- Any notice required or permitted under this Contract may be given by ordinary mail at the address contained in this Contract, but such address may be changed by written notice given by one party to the other from time to time. Notice shall be deemed received in the ordinary course of the mail. This agreement shall be deemed to have been entered into the County of Orange, State of California.

LIMITATIONS

Our findings, interpretations, analyses, and recommendations are professional opinions, prepared and presented in accordance with generally accepted professional practices and are based on observation, laboratory data and our professional experience. Consultant does not assume responsibility for the proper execution of the work by others by undertaking the services being provided to Client under this agreement and shall in no way be responsible for the deficiencies or defects in the work performed by others not under Consultant's direct control. No other warranty herein is expressed or implied.

APPENDIX A

References

1. Blake, T. F., 2000, *EQFAULT, A Computer Program for the Deterministic Prediction of Peak Horizontal Acceleration from Digitized California Fault* Users Manual and Program, 79pp;

2. California Division of Mines and Geology, 2000, *Digital Images of Official Maps of Alquist-Priolo Earthquake Fault Zones, Southern Region*;

3. California Division of Mines and Geology, *January 1, 1990, Special Studies Zones, Murrieta Quadrangle, Revised Official Map*;

4. California Geological Survey, December 5, 2007, *Seismic Hazard Zones, Murrieta Quadrangle, Official Map*;

5. California Geological Survey, 2007, *Seismic Hazard Zone Report for the Murrieta 7.5-Minute Quadrangle, Riverside County, California*: Seismic Hazard Zone Report 115;

6. Hart, Eart W., Revised 1994, *Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps*: California Division of Mines and Geology Special Publication 42;

7. Kennedy, M.P. and Morton, D.M., *Preliminary Geologic Map of the Murrieta 7.5' Quadrangle, Riverside County, California*: California Geological Survey Open File Report 03-189;

8. Miller, Russell V. et. al., 1991, *Mineral Land Classification of the Temescal Valley Area, Riverside County, California,* California Division of Mines and Geology Special Report 165;

9. United States Geological Survey, 1953 photorevised 1979, *Murrieta Quadrangle, 7.5 Minute Topographic Series.*

APPENDIX B

Field Exploration

a) The site was explored on July 17 and 18, 2017, utilizing a hollow stem drill rig to excavate nine borings to a maximum depth of 18.5 feet below the existing ground surface. The borings were subsequently backfilled.

b) The soils encountered in the excavations were logged and sampled by our Engineering Geologist. The soils were classified in accordance with the Unified Soil Classification System described in *Figure B-1*. The Logs of Borings are presented as *Figures B-2 through B-10*. The logs, as presented, are based on the field logs, modified as required from the results of the laboratory tests. Driven ring and bulk samples were obtained from the excavations for laboratory inspection and testing. The depths at which the samples were obtained are indicated on the logs.

c) The number of blows of the driving weight during sampling was recorded, together with the depth of penetration, the driving weight and the height of fall. The blows required per foot of penetration for given samples was then calculated and shown on the logs.

d) No groundwater or seepage was encountered within any of the boring excavations.

e) Caving occurred in all of the borings to the depths noted on the logs.

UNIFIED SOILS CLASSIFICATION (ASTM D-2487)

PRIMARY DIVISION			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS More than half of materials is larger than #200 sieve size	GRAVELS More than half of coarse fraction is larger than #4 sieve	Clean Gravels (<5% fines)	GW	Well graded gravels, gravel-sand mixture, little or no fines
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		Gravel with Fines	GM	Silty gravels, gravel-sand-silt mixture. Non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures. Plastic fines
	SANDS More than half of coarse fraction is smaller than #4 sieve	Clean Sands (<5% fines)	SW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		Sands with Fines	SM	Silty sands, sand-silt mixtures. Non-Plastic fines.
			SC	Clayey sands, sand-clay mixtures. Plastic fines.
FINE GRAINED SOILS More than half of material is smaller than #200 sieve size	SILTS AND CLAYS	LIQUID LIMIT IS LESS THAN 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts, with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS	LIQUID LIMIT IS GREATER THAN 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts.
	Highly Organic Soils		PT	Peat and other highly organic soils.

CLASSIFICATION BASED ON FIELD TESTS

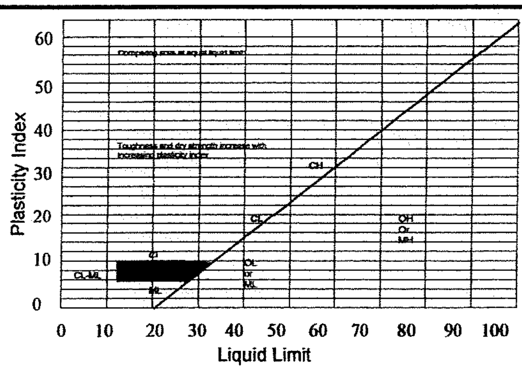
PENETRATION RESISTANCE (PR)	
Sands and Gravels	
Relative Density	Blows/foot
Very loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Clays and Silts		
Consistency	Blows/foot*	Strength**
Very Soft	0-2	0-½
Soft	2-4	¼-½
Firm	4-8	½-1
Stiff	8-15	1-2
Very Stiff	15-30	2-4
Hard	Over 30	Over 4

*Numbers of blows of 140 lb hammer falling 30 inches to drive a 2-inch O.D. (1 3/8 in. I.D.) Split Barrel sampler (ASTM-1568 Standard Penetration Test)

**Unconfined Compressive strength in tons/sq. ft. Read from pocket penetrometer

CLASSIFICATION CRITERIA BASED ON LAB TESTS



Plasticity chart for laboratory Classification of Fine-grained soils

GW and SW – $C_u = D_{60}/D_{10}$ greater than 4 for GW and 6 for SW; $C_c = (D_{30})^2/D_{10} \times D_{60}$ between 1 and 3

GP and SP – Clean gravel or sand not meeting requirement for GW and SW

GM and SM – Atterberg limit below "A" line or P.I. less than 4

GC and SC – Atterberg limit above "A" line P.I. greater than 7

CLASSIFICATION OF EARTH MATERIAL IS BASED ON FIELD INSPECTION AND SHOULD NOT BE CONSTRUED TO IMPLY LABORATORY ANALYSIS UNLESS SO STATED.

Fines (Silty or Clay)	Fine Sand	Medium Sand	Coarse Sand	Fine Gravel	Coarse Gravel	Cobbles	Boulders
Sieve Sizes 200	40	10	4	¾"	3"	10"	

GLOBAL GEO-ENGINEERING, INC.

GEOLOGIC AND SOILS ENGINEERING, IRVINE, CALIFORNIA

26501 Madison Avenue
Murrieta, California

Date: November 2017	**Figure No.:**
Project No.: 7355-04	B-1

Global Geo-Engineering, Inc.
GEOLOGIC AND SOILS TESTING
Irvine, California

26501 Madison Avenue
Murrieta, California

Project 7355-04

LOG OF BORING B-1

Date	: July 17, 2017
Logged By	: KBY
Diameter of Boring	: 8"
Drilling Company	: Cal Pac
Drilling Rig	: Mobile B-61

Drilling Method	: Hollow Stem
Sampling Method	: California Modified
Hammer Weight (lbs)	: 140
Hammer Drop (in.)	: 30

Sample Type: Ring; Bulk; Standard Penetration Testing

Water Levels: Groundwater Encountered; Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Relative Compaction	Water Level	USCS	GRAPHIC	DESCRIPTION
0							ML		Sandy SILT: grayish brown, slightly moist, soft to firm, porous
	Bulk / Ring	5.3	102.2	16					
							ML		Sandy Clayey SILT: olive brown, slightly moist to moist, soft
5	Ring / Bulk	10.1	106.6	9					ALLUVIUM
							SL		Sandy SILTSTONE: olive brown, slightly moist to moist, medium stiff
	Ring	6.4	108.9	24					
10									
									@12' light olive brown, slightly more sandy, medium stiff to stiff
	Ring	5.1	120.3	31					
15							SS		SANDSTONE: medium to coarse grained, yellow brown, slightly moist, medium dense with Silty SANDSTONE interbeds
	Ring	4.9	107.3	34					PAUBA FORMATION
									Bottom of Boring at 18 feet:
20									
25									

Notes:
1. Caving to 9 feet after augers were removed
2. No groundwater or seepage encountered
3. Boring backfilled

Global Geo-Engineering, Inc. GEOLOGIC AND SOILS TESTING Irvine, California	LOG OF BORING B-2	Drilling Method : Hollow Stem Sampling Method : California Modified Hammer Weight (lbs) : 140 Hammer Drop (in.) : 30
26501 Madison Avenue Murrieta, California	Date : July 17, 2017 Logged By : KBY Diameter of Boring : 8" Drilling Company : Cal Pac Drilling Rig : Mobile B-61	
Project 7355-04		

Sample Type: Ring; Bulk; Standard Penetration Testing

Water Levels: Groundwater Encountered; Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Relative Compaction	Water Level	USCS	GRAPHIC	DESCRIPTION
0							SS		Silty SANDSTONE: fine to medium grained, yellow brown, slightly moist, medium dense
	Bulk								
	Ring	4.2	109.2	46					
5	Ring	1.6	101.1	22			SS		SANDSTONE: medium grained, yellow brown, slighlty moist, medium dense
	Ring	7.0	111.3	27					
10									
	Ring	9.5	113.9	23					@12' more Silty with Silty SANDSTONE interbeds
									ALLUVIUM
15							SS		Silty SANDSTONE: fine grained, olive brown, moist, medium dense
	Ring	6.5	110.3	28					PAUBA FORMATION
20									Bottom of Boring at 18 feet: Notes: 1. Caving to 14 feet after augers were removed 2. No groundwater or seepage encountered 3. Boring backfilled
25									

Figure B-3

Global Geo-Engineering, Inc.
GEOLOGIC AND SOILS TESTING
Irvine, California

26501 Madison Avenue
Murrieta, California

Project 7355-04

LOG OF BORING B-3

Date	: July 17, 2017
Logged By	: KBY
Diameter of Boring	: 8"
Drilling Company	: Cal Pac
Drilling Rig	: Mobile B-61

Drilling Method	: Hollow Stem
Sampling Method	: California Modified
Hammer Weight (lbs)	: 140
Hammer Drop (in.)	: 30

Sample Type: Ring; Bulk; Standard Penetration Testing

Water Levels: Groundwater Encountered; Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Relative Compaction	Water Level	USCS	GRAPHIC	DESCRIPTION
0							ML		Sandy SILT: olive brown, slightly moist, medium stiff, porous
	Ring	4.6	104.8	18					
5	Ring	7.1	116.4	25					@5' slight CLAY content, less porous ALLUVIUM
							SS		Silty SANDSTONE: fine to medium grained, yellow brown, slightly moist, medium dense
10	Ring	8.3	114.4	22					
15	Ring	5.9	106.9	45					PAUBA FORMATION
									Bottom of Boring at 15 feet:
20									
25									

Bottom of Boring at 15 feet:

Notes:
1. Caving to 12 feet after augers were removed
2. No groundwater or seepage encountered
3. Boring backfilled

Global Geo-Engineering, Inc.
GEOLOGIC AND SOILS TESTING
Irvine, California

26501 Madison Avenue
Murrieta, California

Project 7355-04

LOG OF BORING B-4

Date : July 17, 2017
Logged By : KBY
Diameter of Boring : 8"
Drilling Company : Cal Pac
Drilling Rig : Mobile B-61

Drilling Method : Hollow Stem
Sampling Method : California Modified
Hammer Weight (lbs) : 140
Hammer Drop (in.) : 30

Sample Type: Ring; Bulk; Standard Penetration Testing

Water Levels: Groundwater Encountered; Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Relative Compaction	Water Level	USCS	GRAPHIC	DESCRIPTION
0							ML		Sandy SILT: olive brown, slightly moist, medium stiff, porous
	Ring	4.4	101.2	18					
									ALLUVIUM
5	Ring	4.8	122.4	45			SL		Sandy SILTSTONE: olive brown to olive gray, slightly moist to moist, medium dense with Silty SANDSTONE interbeds
							SS		Silty SANDSTONE: fine grained, light olive brown to dark yellow brown, slightly moist, medium dense
10	Ring	6.3	118.9	26					
							SS		SANDSTONE: medium to coarse grained, yellow brown, slightly moist, medium dense
15	Ring	7.3	108.8	36					PAUBA FORMATION

Bottom of Boring at 15 feet:

Notes:
1. Caving to 12 feet after augers were removed
2. No groundwater or seepage encountered
3. Boring backfilled

20

25

Figure B-5

Global Geo-Engineering, Inc.
GEOLOGIC AND SOILS TESTING
Irvine, California

26501 Madison Avenue
Murrieta, California

Project 7355-04

LOG OF BORING B-5

Date : July 17, 2017
Logged By : KBY
Diameter of Boring : 8"
Drilling Company : Cal Pac
Drilling Rig : Mobile B-61

Drilling Method : Hollow Stem
Sampling Method : California Modified
Hammer Weight (lbs) : 140
Hammer Drop (in.) : 30

Sample Type: Ring; Bulk; Standard Penetration Testing

Water Levels: Groundwater Encountered; Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Relative Compaction	Water Level	USCS	GRAPHIC	DESCRIPTION
0							SS		Silty SANDSTONE: fine to medium grained, olive gray to yellow brown, slightly moist, medium dense
	Ring	3.7	116.7	34					
5	Ring	3.7	101.6	17					
							SS		SANDSTONE: medium to coarse grained, yellow brown, slightly moist to moist, medium dense
10	Ring	6.8	102.2	26					
15	Standard Penetration Testing			N=25					PAUBA FORMATION

Bottom of Boring at 15.5 feet:

Notes:
1. Caving to 12 feet after augers were removed
2. No groundwater or seepage encountered
3. Boring backfilled

Depth scale: 20, 25

Global Geo-Engineering, Inc.
GEOLOGIC AND SOILS TESTING
Irvine, California

LOG OF BORING B-6

Drilling Method	: Hollow Stem
Sampling Method	: California Modified
Hammer Weight (lbs)	: 140
Hammer Drop (in.)	: 30

26501 Madison Avenue
Murrieta, California

Date	: July 17, 2017
Logged By	: KBY
Diameter of Boring	: 8"
Drilling Company	: Cal Pac
Drilling Rig	: Mobile B-61

Project 7355-04

Sample Type: Ring; Bulk; Standard Penetration Testing

Water Levels: Groundwater Encountered; Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Relative Compaction	Water Level	USCS	GRAPHIC	DESCRIPTION
0							SS		Silty SANDSTONE: fine grained, olive gray to yellow brown, slightly moist, medium dense
2.5	Ring	9.7	106.9	26					
7.5	Ring	7.7	119.7	24					@7' more Silty
12.5	Ring	6.5	113.5	30					
17–18.5	Standard Penetration Testing			N=22					PAUBA FORMATION

Bottom of Boring at 18.5 feet:

Notes:
1. Caving to 14 feet after augers were removed
2. No groundwater or seepage encountered
3. Boring backfilled

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Irvine, California

26501 Madison Avenue
Murrieta, California

Project 7355-04

LOG OF BORING B-7

Date	: July 17, 2017
Logged By	: KBY
Diameter of Boring	: 8"
Drilling Company	: Cal Pac
Drilling Rig	: Mobile B-61

Drilling Method	: Hollow Stem
Sampling Method	: California Modified
Hammer Weight (lbs)	: 140
Hammer Drop (in.)	: 30

Sample Type: Ring; Bulk; Standard Penetration Testing

Water Levels: Groundwater Encountered; Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Relative Compaction	Water Level	USCS	GRAPHIC	DESCRIPTION
0							SL		Sandy SILTSTONE: olive gray, slightly moist to moist, medium stiff to stiff
	Bulk / Ring	17.5	112.7	32					
5	Ring	8.4	108.4	28			SS		Silty SANDSTONE: fine grained, olive gray, slightly moist, medium dense
	Ring	15.6	108.2	39					PAUBA FORMATION
10									Bottom of Boring at 10 feet:

Notes:
1. Caving to 7 feet after augers were removed
2. No groundwater or seepage encountered
3. Boring backfilled

Figure B-8

Global Geo-Engineering, Inc.
GEOLOGIC AND SOILS TESTING

Irvine, California

26501 Madison Avenue
Murrieta, California

Project 7355-04

LOG OF BORING B-8

Date : July 17, 2017
Logged By : KBY
Diameter of Boring : 8"
Drilling Company : Cal Pac
Drilling Rig : Mobile B-61

Drilling Method : Hollow Stem
Sampling Method : California Modified
Hammer Weight (lbs) : 140
Hammer Drop (in.) : 30

Sample Type: Ring; Bulk; Standard Penetration Testing

Water Levels: Groundwater Encountered; Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Relative Compaction	Water Level	USCS	GRAPHIC	DESCRIPTION
0–5	Ring	6.1	109.6	28			SL		Sandy SILTSTONE: olive gray, slightly moist, medium stiff to stiff
5–8	Ring	7.1	115.0	31			SS		Silty SANDSTONE: fine grained, olive gray, slightly moist, medium dense PAUBA FORMATION

Bottom of Boring at 8 feet:

Notes:
1. Caving to 6 feet after augers were removed
2. No groundwater or seepage encountered
3. Boring backfilled

Depth scale: 0, 5, 10, 15, 20, 25

Global Geo-Engineering, Inc.
GEOLOGIC AND SOILS TESTING
Irvine, California

26501 Madison Avenue
Murrieta, California

Project 7355-04

LOG OF BORING P-1

Date : July 17, 2017
Logged By : KBY
Diameter of Boring : 8"
Drilling Company : Cal Pac
Drilling Rig : Mobile B-61

Drilling Method : Hollow Stem
Sampling Method : California Modified
Hammer Weight (lbs) : 140
Hammer Drop (in.) : 30

Sample Type: Ring; Bulk; Standard Penetration Testing

Water Levels: Groundwater Encountered; Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Relative Compaction	Water Level	USCS	GRAPHIC	DESCRIPTION
0							SM		Silty SAND: fine grained, light olive brown, medium dense
	Ring	6.7	120.9	30					
5	Ring	6.6	107.8	15					@5' dark brown, loose to medium dense
							SS		Silty SANDSTONE: fine grained, olive brown, medium dense
	Ring	6.5	121.0	32					PAUBA FORMATION
									Bottom of Boring at 8.5 feet:
10									Notes: 1. Pipe and gravel installed for futured percolation testing 2. No groundwater or seepage encountered
15									
20									
25									

Figure B-10

APPENDIX C

Laboratory Testing Program

The laboratory-testing program was directed towards providing quantitative data relating to the relevant engineering properties of the soils. Samples considered representative of site conditions were tested as described below.

a) Moisture-Density

Moisture-density information usually provides a gross indication of soil consistency. Local variations at the time of the investigation can be delineated, and a correlation obtained between soils found on this site and nearby sites. The dry unit weights and field moisture contents were determined for selected samples. The results are shown on the Logs of Borings.

b) Compaction

A representative soil sample was tested in the laboratory to determine the maximum dry density and optimum moisture content, using the ASTM D1557 compaction test method. This test procedure requires 25 blows of a 10-pound hammer falling a height of 18 inches on each of five layers, in a 1/30 cubic foot cylinder. The results of the tests are presented below:

Boring No.	Sample Depth (ft)	Soil Description	Optimum Moisture Content (%)	Maximum Dry Density (lb/ft^3)
B-1	1-3	Sandy SILT	8.5	128.1

c) Direct Shear

Direct shear tests were conducted on relatively undisturbed, using a direct shear machine at a constant rate of strain. Variable normal or confining loads are applied vertically and the soil shear strengths are obtained at these loads. The angle of internal friction and the cohesion are then evaluated. The samples were tested at saturated moisture contents. The test results are shown in terms of the Coulomb shear strength parameters, as shown below:

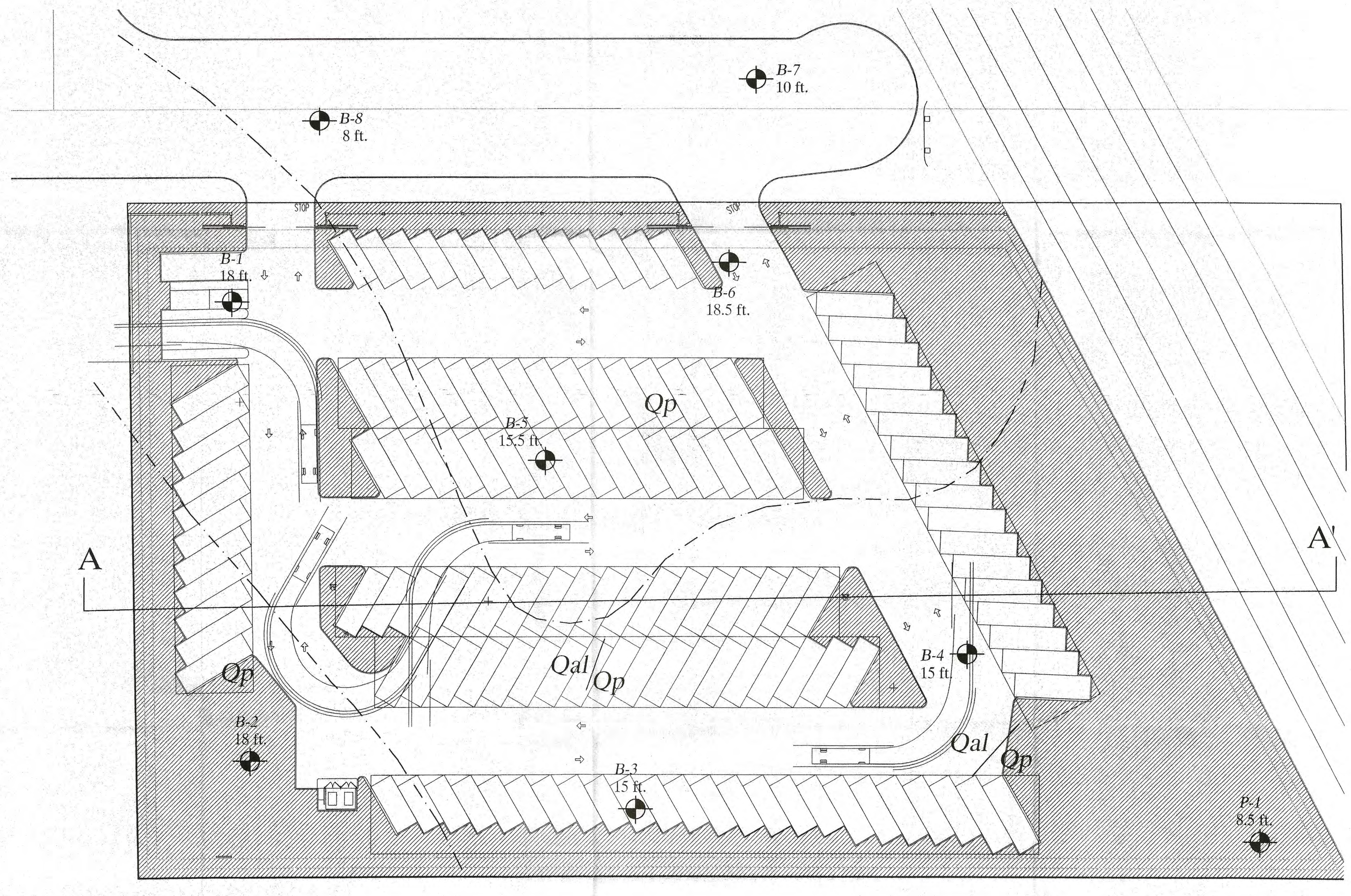
Boring No.	Sample Depth (ft)	Soil Description	Coulomb Cohesion (lb/ft^2)	Angle of Internal Friction (°)	Peak/ Residual
B-2	2	Silty SANDSTONE	200 150	36 31	Peak Residual
B-4	2	Sandy SILT	150 150	29 29	Peak Residual

d) Corrosivity Series Tests

Corrosivity Tests were performed on a representative sample. Soluble sulphate was obtained in accordance with California State Standard Test No. 417A and minimum resistivity was obtained per California State Standard Test No. 643C. The results are given on the following page:

Boring No.	Sample Depth (ft)	Soil Description	pH	Sulphate Content (%)	Soluble Chlorides (%)	Minimum Resistivity (ohm-cm)
B-1	1-3	Sandy SILT	7.6	0.0046	0.0048	2,246
B-2	1-3	Silty SANDSTONE	7.3	0.0037	0.0043	3,952
B-7	1-3	Sandy SILTSTONE	7.6	0.0038	0.0131	1,400

GEOTECHNICAL PLAN



KEY

B-8 8 ft.	APPROXIMATE BORING LOCATION, SHOWING TOTAL DEPTH
Qal	ALLUVIUM
Qp	PAUBA FORMATION
	GEOLOGIC CONTACT
A A'	GEOTECHNICAL CROSS SECTION

SCALE 30 0 30 60 FEET

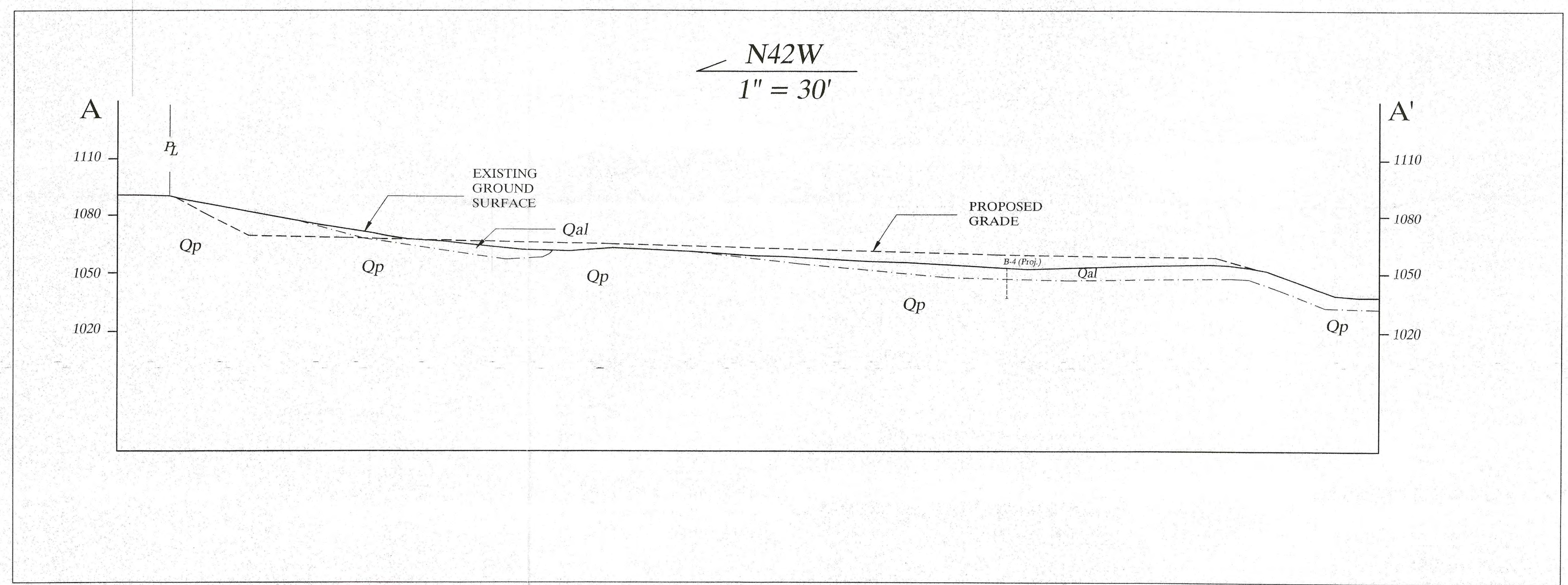
GEOTECHNICAL PLAN

26501 MADISON AVENUE
MURRIETA, CALIFORNIA

GLOBAL GEO-ENGINEERING, INC

PROJECT NO.: 7355-04	DATE: NOVEMBER 2017	PLATE NO.: 1

GEOTECHNICAL CROSS SECTION



GEOTECHNICAL CROSS SECTION		
26501 MADISON AVENUE MURRIETA, CALIFORNIA		
GLOBAL GEO-ENGINEERING, INC		
PROJECT NO.: 7355-04	DATE: NOVEMBER 2017	PLATE NO.: 2

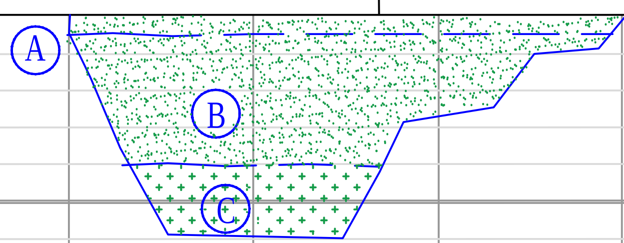
APPENDIX C

LOGS OF EXPLORATORY TRENCHES

Project Name: Lyles Diversified-Murrieta	Logged by: RS	LOG OF TRENCH TR-1
Project Number: G19-1706-10	Elevation: 1078'	Engineering Properties
Equipment: BACKHOE	Location/Grid: SEE PLATE 1	

Depth	Date: 3-15-19 Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0'-1'	A <u>TOPSOIL:</u> Silty SAND; dark brown, damp to moist, loose, fine to medium grained with some clay, roothairs and roots		SM	Bulk @ 0.5'-4.0'		
1'-2'	B <u>WEATHERED PAUBA FORMATION:</u> Clayey Sand; brown, moist, medium dense, fine to medium grained, highly weathered, oxidation staining, friable		SC	Nuke @ 2.5'	12.0	108.7
2'-7'	C <u>BEDROCK (PAUBA FORMATION):</u> Sandstone; light brown, moist, hard, medium to coarse grains, moderately weathered, friable	Qpfs				

GRAPHICAL REPRESENTATION: EAST WALL	SCALE: 1" = 5'	SURFACE SLOPE: LEVEL	TREND: N25E

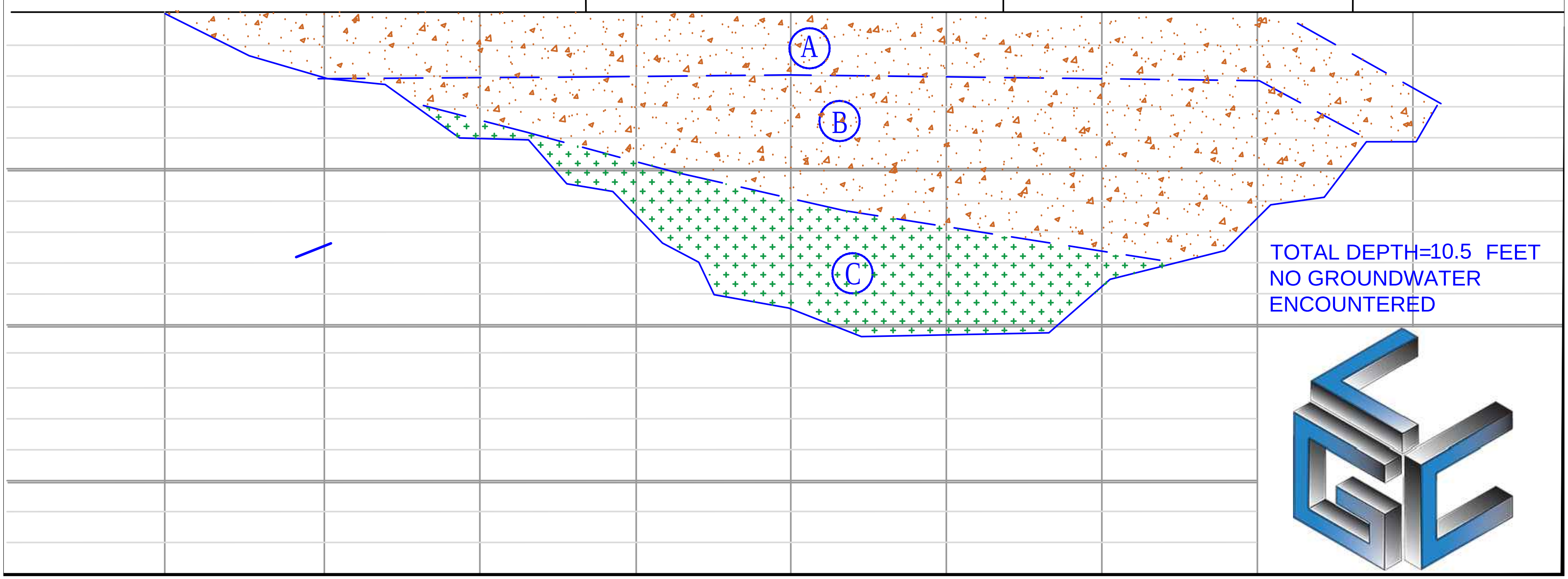


TOTAL DEPTH= 6.0 FEET
NO GROUNDWATER
ENCOUNTERED

Project Name: Lyles Diversified-Murrieta	Logged by: RS	LOG OF TRENCH TR-2
Project Number: G19-1706-10	Elevation: 1077'	Engineering Properties
Equipment: BACKHOE	Location/Grid: SEE PLATE 1	

Depth	Date: 3-15-19 Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-7.0'	A ARTIFICIAL FILL (UNDOCUMENTED): Clayey SAND; dark brown, moist, loose to medium dense, very fine to fine grained, roots and roothairs	Afu	SC	Bulk @ 2'-5'		
				Nuke @ 2'	11.5	116.2
7.0'-10.5'	B Silty SAND, brown, damp to moist, fine to medium grained, medium dense, occasional gravels and cobbles.		SM	Nuke @ 4'	11.8	110.9
				Nuke @ 7'	11.0	119.4
	C BEDROCK (PAUBA FORMATION): Sandstone, yellowish brown, dry to damp, hard, fine to coarse grained, oxidation staining, moderately weathered, friable	Qpfs		Nuke @ 8'	6.6	110.0

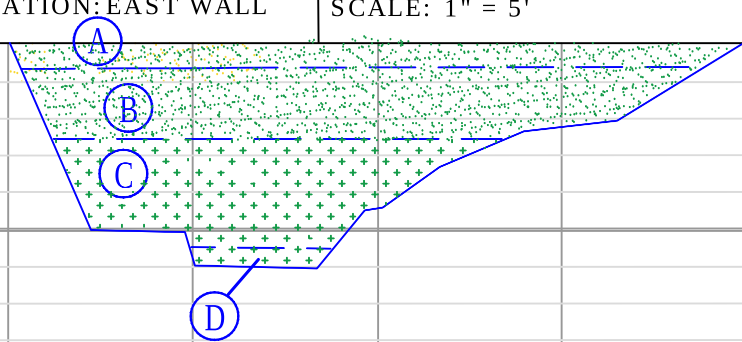
GRAPHICAL REPRESENTATION: EAST WALL | SCALE: 1" = 5' | SURFACE SLOPE: LEVEL | TREND: N20E



Project Name: Lyles Diversified-Murrieta	Logged by: RS	LOG OF TRENCH TR-3
Project Number: G19-1706-10	Elevation: 1080'	Engineering Properties
Equipment: BACKHOE	Location/Grid: SEE PLATE 1	

Depth	Date: 3-15-19	Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-0.8'	A	TOPSOIL: Clayey SAND; dark brown, damp to moist, loose, fine to medium grained, roothairs and roots		SC	Bulk 1'-3'		
0.8'-2.5'	B	WEATHERED PAUBA FORMATION: Poorly Graded SAND; brown, damp, medium dense to dense, medium to coarse grained, pourous, friable		SP	Nubk @2'	5.2	128.2
2.5'-6.0'	C	BEDROCK PAUBA FORMATION: SANDSTONE; greyish brown, dry, hard t o very hard, medium to coarse grained, pourous, slightly to moderately weathered	Qpfs				
6.0'-6.5'	D	SILSTONE; orangish brown, dry, very hard, slightly weathered					

GRAPHICAL REPRESENTATION: EAST WALL	SCALE: 1" = 5'	SURFACE SLOPE: LEVEL	TREND: S8E

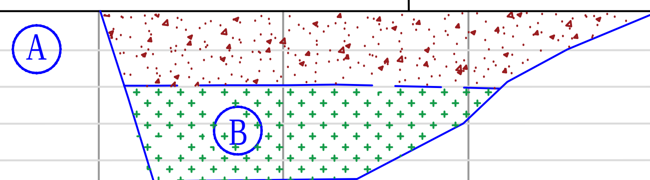


TOTAL DEPTH= 6.5 FEET
NO GROUNDWATER
ENCOUNTERED

Project Name: Lyles Diversified-Murrieta	Logged by: RS	LOG OF TRENCH TR-4
Project Number: G19-1706-10	Elevation: 1070'	Engineering Properties
Equipment: BACKHOE	Location/Grid: SEE PLATE 1	

Depth	Date: 3-15-19	Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-0.5'	A	ARTIFICIAL FILL (UNDOCUMENTED): Clayey SAND; dark reddish brown, damp to moist, loose to medium dense, fine to medium grained, roots and roothairs		SC			
0.5'-4.5'	B	BEDROCK (PAUBA FORMATION): Siltstone; orange to yellowish brown, dry, very hard, moderately to slightly weathered	Qpfs		Nuke @ 1.5'	11.0	115.9

GRAPHICAL REPRESENTATION: WEST WALL	SCALE: 1" = 5'	SURFACE SLOPE: LEVEL	TREND: S10E

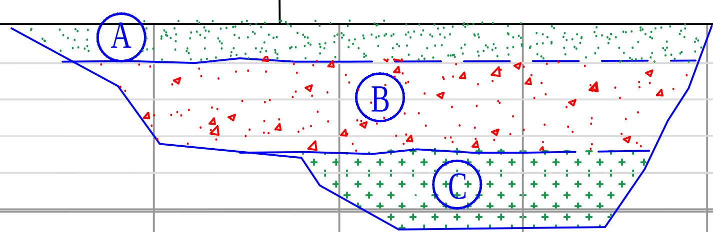


TOTAL DEPTH= 4.5 FEET
NO GROUNDWATER ENCOUNTERED

Project Name: Lyles Diversified-Murrieta	Logged by: RS	LOG OF TRENCH TR-5
Project Number: G19-1706-10	Elevation: 1075'	Engineering Properties
Equipment: BACKHOE	Location/Grid: SEE PLATE 1	

Depth	Date: 3-15-19	Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-1.0'	A	TOPSOIL Clayey SAND/Sandy CLAY; dark brown, damp to moist, loose, very fine to fine grained, roots and roothairs		SC	BULK 1'-3.5'		
1.0'-3.5'	B	YOUNG ALLUVIAL FAN DEPOSITS Sandy SILT; brown, damp to dry, firm, fine grained, pinhole pores and poreholes, roothairs	Qyf	ML	Nuke @ 1.5'	9.0	99.4
3.5'-5.5'	C	BEDROCK (PAUBA FORMATION): Silstone; yellowish brown, dry, moderately hard to hard, fine to very fine grained, moderately weathered	Qpfs				

GRAPHICAL REPRESENTATION: WEST WALL	SCALE: 1" = 5'	SURFACE SLOPE: LEVEL	TREND: S2W

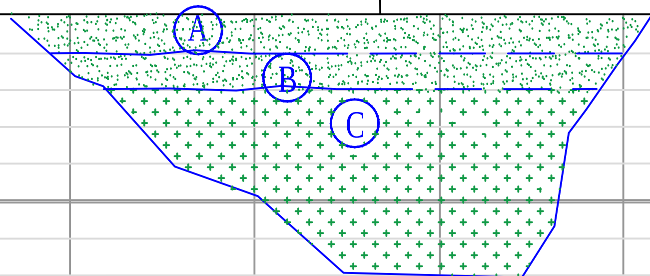


TOTAL DEPTH= 5.5 FEET
NO GROUNDWATER ENCOUNTERED

Project Name: Lyles Diversified-Murrieta	Logged by: RS	LOG OF TRENCH TR-6			
Project Number: G19-1706-10	Elevation: 1065'	Engineering Properties			
Equipment: BACKHOE	Location/Grid: SEE PLATE 1				

Depth	Date: 3-15-19	Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-1.0'	A	TOPSOIL: Clayey SAND; dark brown, moist, loose, fine to medium grained, roots and roothairs,		SC	Bulk @ 2'-5'		
					Nuke @ 1.5'	7.2	114.9
1.0'-2.0'	B	WEATHERED PAUBA FORMATION: Poorly Graded SAND; yellowish brown, dry, medium dense, fine to medium grained, oxidation staining, friable		SP	Nuke @ 5'	4.8	96.8
2.0'-7.0'	C	BEDROCK (PAUBA FORMATION): Sandstone; yellowish brown, damp, hard, medium to coarse grains, friable, moderately weathered	Qpfs				

GRAPHICAL REPRESENTATION: WEST WALL | SCALE: 1" = 5' | SURFACE SLOPE: LEVEL | TREND: N7W

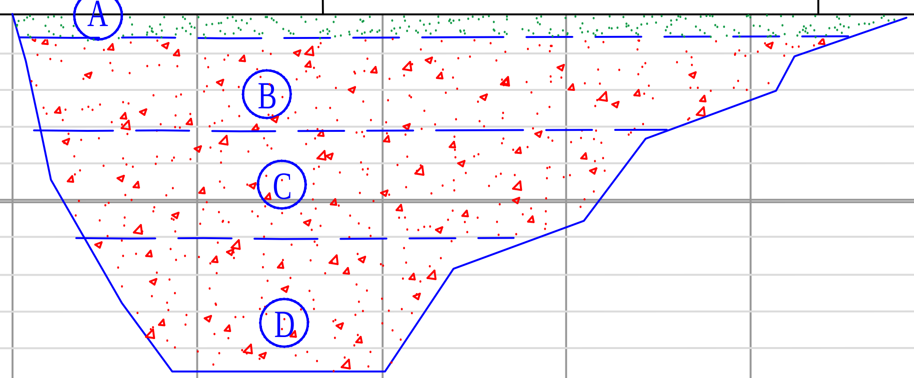


TOTAL DEPTH= 7 FEET
NO GROUNDWATER ENCOUNTERED

Project Name: Lyles Diversified-Murrieta	Logged by: RS	LOG OF TRENCH TR-7
Project Number: G19-1706-10	Elevation: 1057'	Engineering Properties
Equipment: BACKHOE	Location/Grid: SEE PLATE 1	

Depth	Date: 3-15-19 Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-0.5'	A TOPSOIL: Silty SAND; brown, moist, loose, fine to medium grained, trace amount of clay, pores, roots and roothairs		SM	Bulk 0.5'-3'		
0.5'-3.0'	YOUNG ALLUVIAL FAN DEPOSITS: B Sandy SILT; dark brown, moist, loose to medium dense, fine to very fine grained, with some clay	Qyf	ML	Nuke @ 3'	9.6	121.0
3.0'-6.0'	Clayey SAND; dark brown, moist, medium dense, fine to medium grained slightly porous		SC	Rings @ 5'	13.1	120.4
6.0'-9.5'	Silty SAND; yellowish brown, damp to moist, medium to coarse grained, dense, with occasional coarse grains and some clay		SM	Nuke @ 9.5'	10.5	121.3

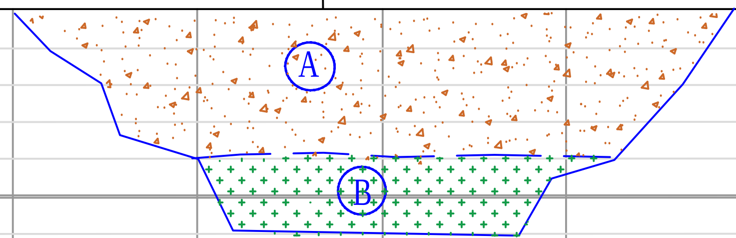
GRAPHICAL REPRESENTATION: WEST WALL | SCALE: 1" = 5' | SURFACE SLOPE: LEVEL | TREND: N10W



TOTAL DEPTH= 9.5 FEET
NO GROUNDWATER ENCOUNTERED

Project Name: Lyles Diversified-Murrieta			Logged by: RS		LOG OF TRENCH TR-8			
Project Number: G19-1706-10			Elevation: 1058'		Engineering Properties			
Equipment: BACKHOE			Location/Grid: SEE PLATE 1		USCS	Sample No.	Moisture (%)	Dry Density (pcf)
Depth	Date: 3-15-19	Description:		Geologic Unit				
0.0'-4.0'	A	ARTIFICIAL FILL UNDOCUMENTED: Silty SAND; dark brown, moist, loose to medium dense, very fine to fine grained, roots and roothairs.		Afu	SM			
4.0'-6.0'	B	WEATHERED PUABA FORMATION: Sandy SILT; yellowish brown, damp, medium dense, very fine to fine grained.			ML			

GRAPHICAL REPRESENTATION: WEST WALL | SCALE: 1" = 5' | SURFACE SLOPE: LEVEL | TREND: N2E

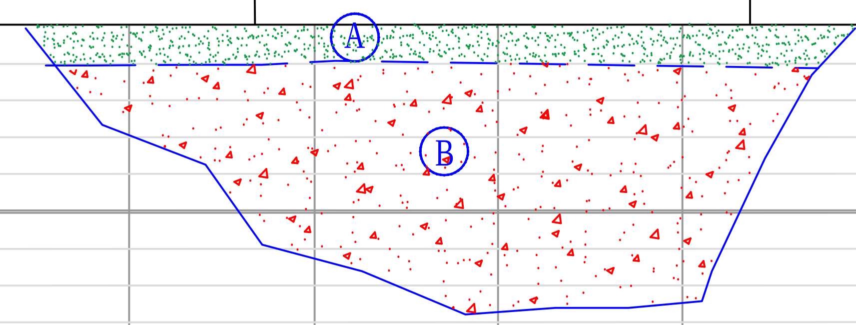


TOTAL DEPTH= 6.0 FEET
NO GROUNDWATER ENCOUNTERED

Project Name: Lyles Diversified-Murrieta		Logged by: RS	LOG OF TRENCH TR-9	
Project Number: G19-1706-10		Elevation: 1053.5'	Engineering Properties	
Equipment: BACKHOE		Location/Grid: SEE PLATE 1		

Depth	Date: 3-15-19	Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-1.0'	A	TOPSOIL: Silty SAND; reddish brown, very moist, soft to loose, very fine to medium grained, trace amounts of clay, some pores, roots and roothairs,		SM			
1.0'-7.5'	B	YOUNG ALLUVIAL FAN DEPOSITS: Silty SAND to Sandy CLAY; dark brown/black, wet, loose to medium dense, soft to firm, very fine to medium grained, with possibly some coarse grains, pores with seeping water from previous rain (Due to water in trench unable to fully profile excavation. Above descriptions are based on visual observation from top of trench.)	Qyf	SM-ML			

GRAPHICAL REPRESENTATION: WEST WALL	SCALE: 1" = 5'	SURFACE SLOPE: LEVEL	TREND: N5W



TOTAL DEPTH= 7.5 FEET
NO GROUNDWATER ENCOUNTERED

APPENDIX D

LABORATORY TESTING PROCEDURES AND TEST RESULTS

APPENDIX D

Laboratory Testing Procedures and Test Results

The laboratory testing program was directed towards providing quantitative data relating to the relevant engineering properties of the soils. Samples considered representative of site conditions were tested in general accordance with American Society for Testing and Materials (ASTM) procedure and/or California Test Methods (CTM), where applicable. The following summary is a brief outline of each test type and a table summarizing the test results.

Soil Classification: Soil types were classified according the Unified Soil Classification System (USCS) in accordance with ASTM Test Methods D2487 and D2488. The USCS is based on the Atterberg Limits and grain-size distribution of a soil. The soil classifications (and/or group symbol) are shown on the laboratory test data and the logs.

Maximum Dry Density and Optimum Moisture Content Tests: The maximum dry density and optimum moisture content tests were performed in accordance with ASTM D1557. The test results are presented in the table below:

SAMPLE LOCATION	SAMPLE DESCRIPTION (USCS)	MAXIMUM DRY DENSITY (% by weight)	OPTIMUM MOISTURE CONTENT (%)
TR-3 @ 1.0'-3.0'	Silty Fine-Coarse SAND (SM)	131.7	8.0
TR-5 @ 1.0'-3.5'	Clayey Fine SAND (SC)	130.9	9.0

Soluble Sulfate Content: The soluble sulfate content testing was performed in accordance with CTM 417. The test results are presented in the table below:

SAMPLE LOCATION	SAMPLE DESCRIPTION (USCS)	SULFATE CONTENT (ppm)	SULFATE EXPOSURE
TR-3 @ 1.0'-3.0'	Silty Fine-Coarse SAND (SM)	Non-Detect	Negligible
TR-5 @ 1.0'-3.5'	Clayey Fine SAND (SC)	61	Negligible

Chloride Content: Chloride content testing was performed in accordance with CTM 422. The test results are presented in the table below:

SAMPLE LOCATION	SAMPLE DESCRIPTION (USCS)	CHLORIDE CONTENT (ppm)
TR-3 @ 1.0'-3.0'	Silty Fine-Coarse SAND (SM)	63
TR-5 @ 1.0'-3.5'	Clayey Fine SAND (SC)	32

Minimum Resistivity and pH Tests: Minimum resistivity and pH tests were performed in accordance with CTM 643. The test results are presented in the table below:

SAMPLE LOCATION	SAMPLE DESCRIPTION (USCS)	pH	MINIMUM RESISTIVITY (ohm-cm)
TR-3 @ 1.0'-3.0'	Silty Fine-Coarse SAND (SM)	8.4	5,800

Direct Shear: Direct shear testing was performed in accordance with ASTM D3080 on a selected remolded sample, which was soaked for a minimum of 24 hours under a surcharge equal to the applied normal force during testing. After transfer of the sample into the shear box, and reloading the sample, pore pressures set up in the sample due to the transfer were allowed to dissipate for a period of approximately 1 hour prior to application of shearing force. The sample was tested under various normal loads, a motor-driven, strain-controlled, direct-shear testing apparatus at a strain rate of about 0.005 inch per minute (depending upon the soil/bedrock type). The test results are presented in the table below:

SAMPLE LOCATION	SAMPLE DESCRIPTION (USCS)	ANGLE OF INTERNAL FRICTION (degrees)	COHESION (pcf)
TR-5 @ 1.0'-3.5'	Clayey Fine SAND (SC)	29	1,010

Atterberg Limits: The liquid and plastic limits and plasticity index (Atterberg Limits) tests were performed in accordance with ASTM D4318. The test results are presented in the table below:

SAMPLE LOCATION	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS SOIL SYMBOL
TR-2 @ 8.0'	28	14	14	CL or OL
TR-5 @ 1.0'-3.5'	26	13	13	CL or OL

Expansion Index Tests: Expansion Index testing was performed in accordance with ASTM D4829. Specimens are molded under a given compactive energy to approximately the optimum moisture content and approximately 50 percent saturation or approximately 90 percent relative compaction. The prepared 1-inch thick by 4-inch diameter specimens are loaded to an equivalent 144 psf surcharge and are inundated with tap water until volumetric equilibrium is reached. The test results are presented in the table below:

SAMPLE LOCATION	SAMPLE DESCRIPTION (USCS)	EXPANSION INDEX	EXPANSION POTENTIAL
TR-3 @ 1.0'-3.0'	Silty Fine-Coarse SAND (SM)	0	Very Low
TR-5 @ 1.0'-3.5'	Clayey Fine SAND (SC)	37	Low

R-Value: The resistance R-values was determined by the ASTM D2844 soils test: The sample was prepared, and the exudation pressure and R-value were determined. These results were used for preliminary asphaltic concrete pavement design purposes.

SAMPLE LOCATION	SAMPLE DESCRIPTION	R-VALUE
TR-3 @ 1.0'-3.0'	Silty Fine-Coarse SAND (SM)	68

APPENDIX E

GENERAL EARTHWORK AND GRADING SPECIFICATIONS FOR ROUGH GRADING

APPENDIX E

LGC Geo-Environmental, Inc.

General Earthwork and Grading Specifications for Rough Grading

1.0 General

1.1 Intent: These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 The Geotechnical Consultant of Record: Prior to commencement of work, the owner shall employ a qualified Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to confirm that the attained level of compaction is being accomplished as specified. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor: The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the project plans and specifications. The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "equipment" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading.

The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate personnel will be available for observation and testing. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified. It is the contractor’s sole responsibility to provide proper fill compaction.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing: Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 10 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed. The contractor is responsible for all hazardous waste relating to his work. The Geotechnical Consultant does not have expertise in this area. If hazardous waste is a concern, then the Client should acquire the services of a qualified environmental consultant.

2.2 Processing: Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of oversize material and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Overexcavation: In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching: Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 (h:v) shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 Evaluation/Acceptance of Fill Areas: All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General: Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 Oversize: Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 ***Import:*** If importing of fill material is required for grading, proposed import material shall meet all the requirements of this section. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined, and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 ***Fill Layers:*** Approved fill material shall be placed in areas prepared to receive fill in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 ***Fill Moisture Conditioning:*** Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society for Testing and Materials (ASTM Test Method D1557-91).

4.3 ***Compaction of Fill:*** After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557-91). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 ***Compaction of Fill Slopes:*** In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557-91.

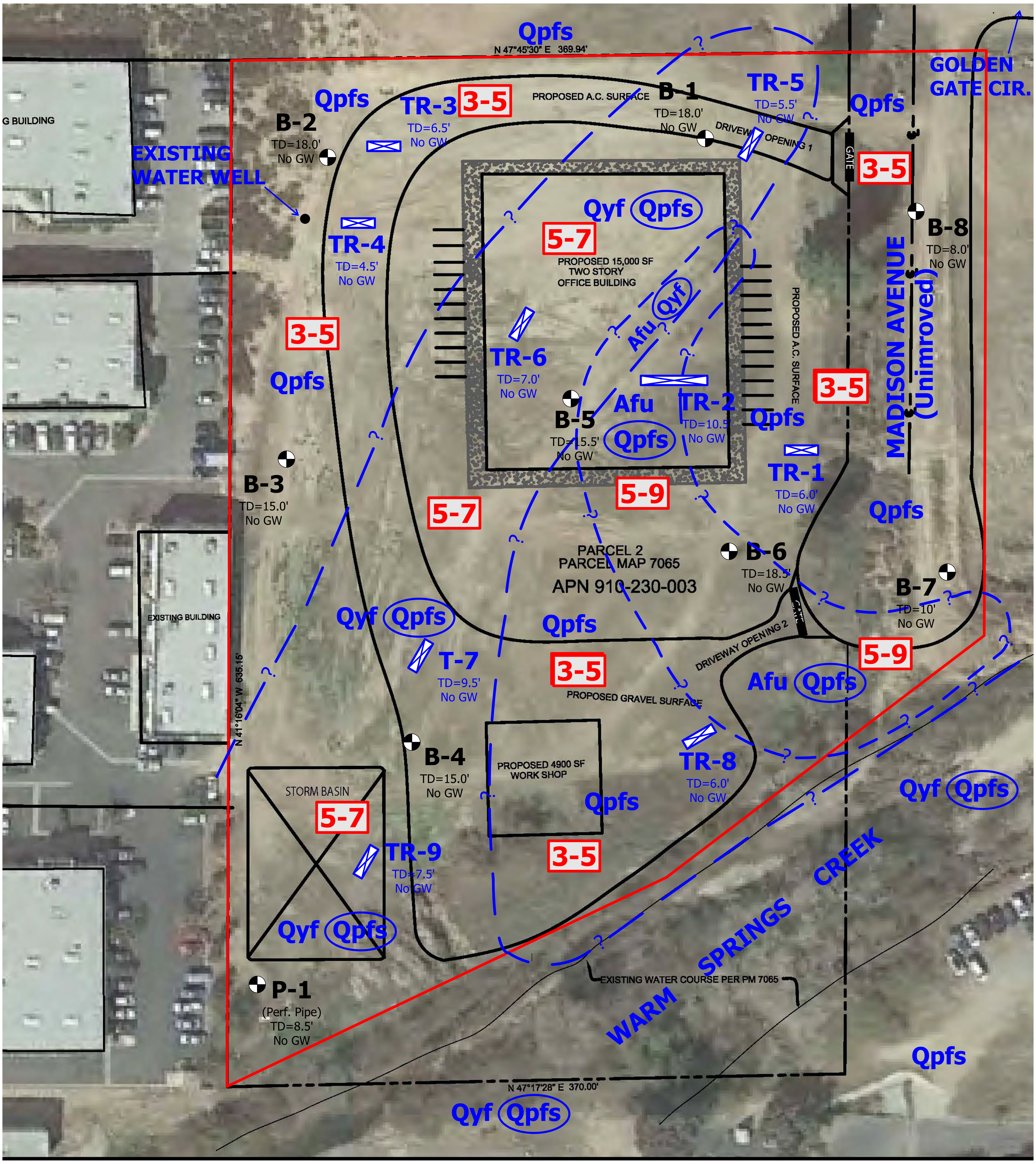
4.5 ***Compaction Testing:*** Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 ***Frequency of Compaction Testing:*** Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one (1) test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 ***Compaction Test Locations:*** The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two (2) grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and City requirements and standards. The Geotechnical Consultant may recommend additional subdrain and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.



LEGEND

(Map Locations Are Approximate)

Geologic Units

Afu - Artificial fill, undocumented, existing

Qyf - Young alluvial fan deposits (Holocene-late Pleistocene)

Qpfs - Pauba Formation, Sandstone Member (Pleistocene) - Circled where buried by Qyf

Map Symbols

Limits of This Report

Geologic Contact – Queried Where Approximate

3-5 Approximate Depths of Overexcavation Below Existing Grade (ft.)

TR-9 TD=7.5' No GW — Exploratory Trench Location (LGC)

B-8 TD=8.0' No GW — Exploratory Boring Location (Global - 2017)

0 ft. 15 ft. 30 ft. 60 ft.

Map distances are approximate

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PLATE 1
GEOTECHNICAL MAP
Proposed Commercial Development
26501 Madison Avenue, City Of Murrieta,
Riverside County, California

Project Name	Lyles Diversified – Murrieta
Project Number	G19-1706-10
Client	Lyles Diversified
Scale	1" = 30'
Date	April 2019
Reference	dk Greene Consulting, Inc., Site Plan, undated
Plate Number	1 of 1